

# An urban image in an urbanized landscape: measuring the visual impact of Tibur's amphitheater

Matthew Notarian 

Hiram College <notarianmf@hiram.edu>

**Abstract:** Though infrequently used and largely superfluous, amphitheatres were often the most physically imposing and ideologically charged structures in a Roman city. The preponderance of extramural amphitheatres in Italy and their appearance in visual culture confirm they were potent markers of urban life and civic status. This paper contextualizes Tibur's imperial amphitheater within the Roman suburbium's persistent urban sprawl and villas, especially Hadrian's Villa, using a novel GIS visibility analysis. Its apparent size from various points in the surrounding landscape is quantified within empirical and qualitative scales developed for modern visual impact assessments. The results demonstrate the amphitheater's suburban location did more than integrate Tibur's extramural growth into the older urban center. It emphasized the city's urban appearance, even from long distances, and monumentalized alternate routes to the city used by the villa-owning elite, countering the ambiguous status of a liminal city that was both Rome's annex and an autonomous municipium.

**Keywords:** amphitheatres, Roman urbanism, GIS, visibility analysis, suburbium, landscapes

## Introduction

Amphitheatres dominated many Imperial Roman cities with their tall, imposing façades. Their construction demanded a considerable outlay of money and urban space, yet they were not a necessity for civic life. Arena spectacles, occurring only a handful of times per year, had long made do with fora or other open public spaces.<sup>1</sup> The rationale behind amphitheater projects clearly transcended pragmatic function. As often noted, permanent amphitheatres created mechanisms for reifying and negotiating social hierarchies, reinforcing social control and inculcating Roman values, asserting allegiance to the imperial household, fostering economic opportunity, and cultivating civic pride and identity, especially in comparison to neighboring communities.<sup>2</sup> Significantly, two-thirds of Italy's amphitheatres were built in suburban districts, enhancing their visibility to non-local audiences as much as reacting to the practicalities of space and crowd control.<sup>3</sup> Extramural placement also offered added benefits such as formally integrating suburban development into the monumental civic center, designating it as fully urban space.<sup>4</sup> In short, amphitheatres materialized elite urban ideologies through their enduring physical presence and the periodic events staged within.<sup>5</sup>

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<sup>1</sup> Vitruvius. *De arch.* 5.1.1.

<sup>2</sup> E.g., Hopkins 1983; Futrell 1997; Bomgardner 2021; Patterson 2006, 125–48; Laurence et al. 2011, 259–84.

<sup>3</sup> Bonetto 2003.

<sup>4</sup> Emmerson 2020, 163–95.

<sup>5</sup> DeMarrais et al. 1996.

Tibur's modest extramural amphitheater, built ca. 125 CE, epitomizes these characteristics. Yet, as part of Rome's suburbium, the city's urban identity was ambiguous and diluted, which lent its arena exceptional symbolic value. Formerly a proud and independent Latin city-state situated at the interface of Latium, Sabina, and the Apennines, Tibur had long since evolved into a suburban retreat for the capital's most privileged classes. Centuries of intensifying villa building in its immediate hinterland, paired with Rome's increasing suburban sprawl, had rendered it an extension of the capital's socio-political networks. The construction of Hadrian's Villa, contemporaneous with the amphitheater's appearance, marked a culminating moment. A late arrival in comparison to Italy as a whole, Tibur's amphitheater was the largest urban project undertaken in over two centuries, offering both tangible and ideological benefits to the community. Not since the monumental sanctuary of Hercules Victor (early 1st c. BCE) had a single project so profoundly altered the cityscape.<sup>6</sup>

This article explores the amphitheater as a response to suburbanization, arguing it capitalized on Tibur's elevated position to maximize its visibility for travelers arriving from or traveling to Rome, while also monumentalizing alternate routes into the city for the villa-owning elite. Viewed from the west, the amphitheater presented an unmistakably urban image within a crowded suburban landscape—a physical manifestation of reclaimed urban status. This premise is assessed quantifiably using a novel GIS visibility analysis that estimates the apparent size of the amphitheater's façade from various points in the surrounding landscape. These metrics are evaluated against empirical and qualitative scales developed for modern landscape management and visual impact assessment but contextualized within the unique social and political dynamics of 2nd-c. Tibur. In sum, this exploration illustrates how Tibur was set apart from its Italian peers, occupying a liminal role at the margins of Rome's formidable zone of influence, which presented unique challenges, but also opportunities, for maintaining its autonomous urban identity.

### **Tibur and its amphitheater in the reign of Hadrian**

The amphitheater was constructed about 300 m south of Tibur's Republican walls in an area of suburban development that had emerged by the 1st c. BCE (Fig. 1). Mentioned in documentation as late as the 15th c., the arena was subsequently rediscovered in 1948, then excavated in sporadic campaigns extending until the 1990s.<sup>7</sup> The results have only been minimally published.<sup>8</sup> The structure is poorly preserved, with extant walls no more than 3 m high, likely due to purposeful destruction and fill concurrent with the construction of the adjacent 15th c. fortress, the Rocca Pia. Prior to that, it may have been repurposed as a fortress itself in the 13th c., at which time its spaces were re-exposed and interior connections reconfigured.<sup>9</sup> Its Hadrianic construction date was determined on the basis of a brick stamp bearing a consular date of 123 CE and an inscription mentioning its dedication

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<sup>6</sup> Coarelli 1987; Giuliani 2004. The sanctuary became synonymous with the city in 1st and early 2nd-c. CE literature (Bodei Giglioni 1977, 61).

<sup>7</sup> *Commentaries of Pius II*, 5.27.6: *...vestigia erant nobilis amphitheatri quae arx omnia consumpsit* ("... there were ruins of a noble amphitheater, but the fortress [i.e., the Rocca Pia] destroyed them all").

<sup>8</sup> Facenna 1948; Giuliani 1970, 239–43 n. 141; Frontoni 1997; Tosi 2003, 305–8.

<sup>9</sup> Frontoni 1997, 130–31.

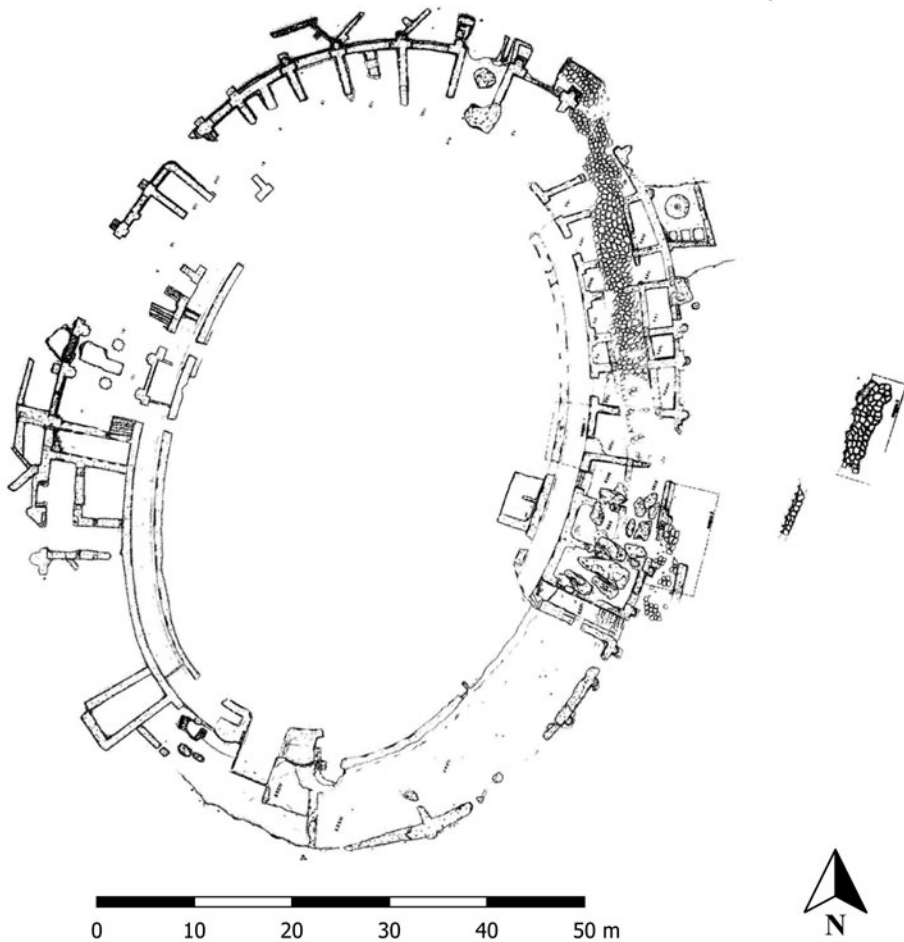


Fig. 1. Plan of Tibur's amphitheater. (After Frontoni 1997, pl. XXIV.)

by a local leader and civic patron, M. Tullius Blaesus, active in the mid-2nd c.<sup>10</sup> A modestly sized structure, 83 by 64 m with an internal arena of 57 by 37 m, it could accommodate approximately 7,600 spectators, a fraction of the surrounding region's massive population.<sup>11</sup> It lacks most of the advanced engineering found in the empire's preeminent 2nd-c. structures, with only a single covered ambulatory running below the *cavea*, and an unexcavated underground passage aligned with its minor axis. Its southern and southeastern *cavea* is supported directly on the slope of Monte Ripoli, built without radial foundation walls, while most of the structure was carried on masonry vaults.<sup>12</sup> The masonry is

<sup>10</sup> Frontoni 1997, 130. Stamp: [P]AETIN (consulship of Q. Articuleius Paetinus and L. Venuleius Apronianus Octavius Priscus); Inscription: CIL XIV 4259 = *Inscr. Ital.* IV 202 = ILS 5630. Blaesus oversaw a statue dedicated to L. Minicius Natalis Quadronius Verus, proconsul of Africa (ca. 149–154 CE) and civic patron (CIL XIV 3599 = *Inscr. Ital.* IV 113; also see PIR<sup>2</sup> M, 620). Two Dressel 7–11 amphoras beneath the foundation, perhaps for drainage, reinforce an early 2nd-c. *terminus post quem* (Frontoni 1997, 129).

<sup>11</sup> Hanson and Ortman 2020, appendix table 2.

<sup>12</sup> A rare example of Golvin's (1988, 407) "third construction style", that is, partially resting on a hillside, but also "hollow" (1988, 157).

*opus mixtum*, although the façade presents travertine blocks decorated with semi-columns aligned with the radial walls.

Despite the amphitheater's common attribution to Blaesus, he was probably not the sole benefactor. The key inscription, primarily dedicated to Blaesus's son, M. Tullius Rufus, only mentions, in the crowning, that his father donated a sum of money and labor towards the structure's "dedication" (*dedicatio*), which could be construed as ceremonies related to its inauguration or other final preparations.<sup>13</sup> Nonetheless, Blaesus is a comparatively rare example of a local civic patron. Likely a decurion, he belonged to Tibur's tribe Camilia, held several local offices, and appears, along with his wife and children, in other inscriptions, such as one overseeing an honorary monument approved by the city council. Most importantly, he held the prestigious positions of *curator fani Herculis Victoris*, supervising the city's famous sanctuary, and *salius*, here devoted to the same deity, both rarities for a local citizen.<sup>14</sup> Even so, of the almost two dozen attested civic patrons, half came from the senatorial class, likely reflecting the town's efforts to co-opt nearby villa owners.<sup>15</sup> Moreover, Trajan and Hadrian's reigns saw an influx of elite Spanish families into Tibur.<sup>16</sup> Their arrival seems to have spurred renovation and enlargement in several luxury villas in the city's territory.<sup>17</sup> Many of the formerly modest productive centers closest to Hadrian's Villa expanded to rival the older massive uphill estates, presumably as proximity to the imperial seat raised their social and political value.<sup>18</sup> The city's unusually rich epigraphic record, largely originating in statues honoring senatorial villa owners within the porticoes of the sanctuary of Hercules Victor and other public civic zones, almost certainly stems from otherwise unrecorded acts of benefaction.<sup>19</sup> While our fragmentary knowledge of the city's urban topography makes it difficult to verify whether this stimulated a period of urban renewal beyond the amphitheater, it does appear Tibur acquired renewed prestige in the period spanning Trajan to the Antonines.<sup>20</sup>

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<sup>13</sup> See n. 10 above. Twenty thousand HS and 200 *operae* (man-days of labor): not enough for its total construction (Futrell 1997, 136; Torelli 1995, 233).

<sup>14</sup> He also served as *pontifex* (CIL XIV 4258 = *Inscr. Ital.* IV 201 = ILS 6233). For the other texts, see n. 10 above.

<sup>15</sup> Eleven to 13 senatorial patrons are identified in the 2nd–3rd c. CE. The vast majority were not from Tibur. Of those remaining, one equestrian, five decurial, and three of unknown status, many were likely local. See Nicols 2013; Bourne 1916, 54–56.

<sup>16</sup> Syme 1982–1983; Mari 2002.

<sup>17</sup> Mari 2002, 183–87; Marzano 2007, 171–72. E.g., the massive villa at Quintiliolo (Marzano 2007, 581; Mari and Boanelli 1991).

<sup>18</sup> E.g., the villa about 0.5 km south of Hadrian's Villa (Colle delle Foce), with large terrace (ca. 8,000 m<sup>2</sup>) built mainly in *opus mixtum* (Mari 1991b, 228–29 n. 149); to its southeast, the Vibii Vari villa was extensively expanded with a second Hadrianic terrace (based on brick stamps), and possibly belonged to the eponymous 134 CE consul (Marzano 2007, 573; Mari 1991b, 237–34 n. 157; *Inscr. Ital.* IV 132). Between these, the villa of the Lolli Paolini appears to be Hadrianic *ex novo* (Mari 1991b, 233–37 n. 153). Other renovations (Pianelle dei Signori Reali [Tombrägel 2012, 165; Mari 1991b, 163–67 n. 87]; Grotta Papale [Mari 1991b, 179–83 n. 104; Tombrägel 2012, cat. no. 42]) are dated broadly mid-1st to 2nd c. CE.

<sup>19</sup> Eck 1996, 305–6.

<sup>20</sup> Mari (2002, 187–97) considers *opus mixtum* in Tivoli and its territory of similar quality to that in Hadrian's Villa evidence of contemporary construction, yet masonry dating remains tentative without stratigraphic data.

## Measuring the visual impact of Tibur's amphitheater

The office of *curator fani Herculis Victoris* was mostly held by powerful non-local senators of consular status or *equites*, some of whom also served as *salius* and patron in Tibur.<sup>21</sup> This unexpected interest in local religious offices is likely due to the close association between the sanctuary of Hercules Victor and the emperor, which traces its origins to Augustus.<sup>22</sup> After Augustus seized its treasury during the Perusine War, the theater received marble decor, perhaps by imperial benefaction as part of his promised restitution.<sup>23</sup> Later Augustus allegedly administered justice from its porticoes during his sojourns in the territory.<sup>24</sup> These connections may have been reaffirmed by Hadrian both in his efforts to emulate the first *princeps* and in his adoption of Tibur as seat of his villa, a mere 2.5 km from the sanctuary.<sup>25</sup> The fact that Blaesus shared offices with some of Rome's most prominent aristocrats with close imperial ties is testament to Tibur's extraordinary integration into powerful networks. Yet, as a local citizen, it is fitting he would be at least partly responsible for the largest benefaction the city had seen in two centuries, especially one that served to enhance its urban façade and regional standing. One can only speculate whether his connection to the imperial elite may have facilitated this project in any way, or if any of these other dignitaries were responsible for the unaccounted-for funding behind its construction. Such ties could have been instrumental in obtaining the emperor's approval, necessary for the construction of a large-scale entertainment structure.<sup>26</sup> While it did not technically violate the imperial monopoly on public building and spectacle in Rome, Tibur's proximity and integration into the capital's social networks may have complicated such benefactions, providing an expedient outlet for the senatorial elite long barred from conspicuous display there.<sup>27</sup> Moreover, Hadrian, a renowned builder across the empire, was not hostile to amphitheater projects during his reign, but direct evidence of this is scarce.<sup>28</sup> He likely funded some restoration of Capua's arena and was responsible for the spectacular new edifice in his ancestral *patria* Italia.<sup>29</sup>

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<sup>21</sup> Six or seven senators, mostly 2nd c. CE, are attested as *curator*, while three or four may have been *salius*: Giletti 2018, 400–9; Várhelyi 2010, 216–18; Syme 1982–1983, 261.

<sup>22</sup> Bodei Giglioni 1977, 66–67. The local *augustales* were known as *Herculanei (et) Augustales* and at least partially served the imperial cult (e.g., *CIL* XIV 3561). See Giletti 2018; Jaczynowska 1981, 643–45.

<sup>23</sup> *App. B Civ.* 5.22.87; 5.24.97; Bodei Giglioni 1977, 34–35; Giuliani 2004, 49–50; Pintucci 2006; Pintucci 2007. Sculptural and architectural fragments are stylistically dated to the early Augustan era. Epigraphic evidence from the theater excavation, which may confirm an Augustan intervention, has not yet been published.

<sup>24</sup> Suet. *Aug.* 72.2.

<sup>25</sup> Mari 2002, 182–83.

<sup>26</sup> Aemilius Macer (*Dig.* 50.10.3) specifies new amphitheatres, theatres, or circuses required the emperor's approval, along with buildings that could inflame civic rivalries or sedition. Although directed towards provincial governors, this may also have applied to Italy, perhaps reflecting policy earlier than Macer's Severan floruit. See Futrell 1997, 124–25; Bomgardner 2021, 32–33.

<sup>27</sup> Eck 1984, 137–42. On the Early Imperial suburbium as arena for aristocratic competition, see Witcher 2020, 119–20.

<sup>28</sup> Futrell 1997, 131–32; Boatwright 2000, 125–27.

<sup>29</sup> Capua: *CIL* X 3832. Hadrian's role depends on a lacuna restoration. See Bomgardner 2021, 169–70. Italia: Cass. Dio 69.10.1; Boatwright 2000, 162–64. Hadrian's donation is inferred from Dio's mention of "gifts" to his hometown, archaeological chronology, and construction techniques.

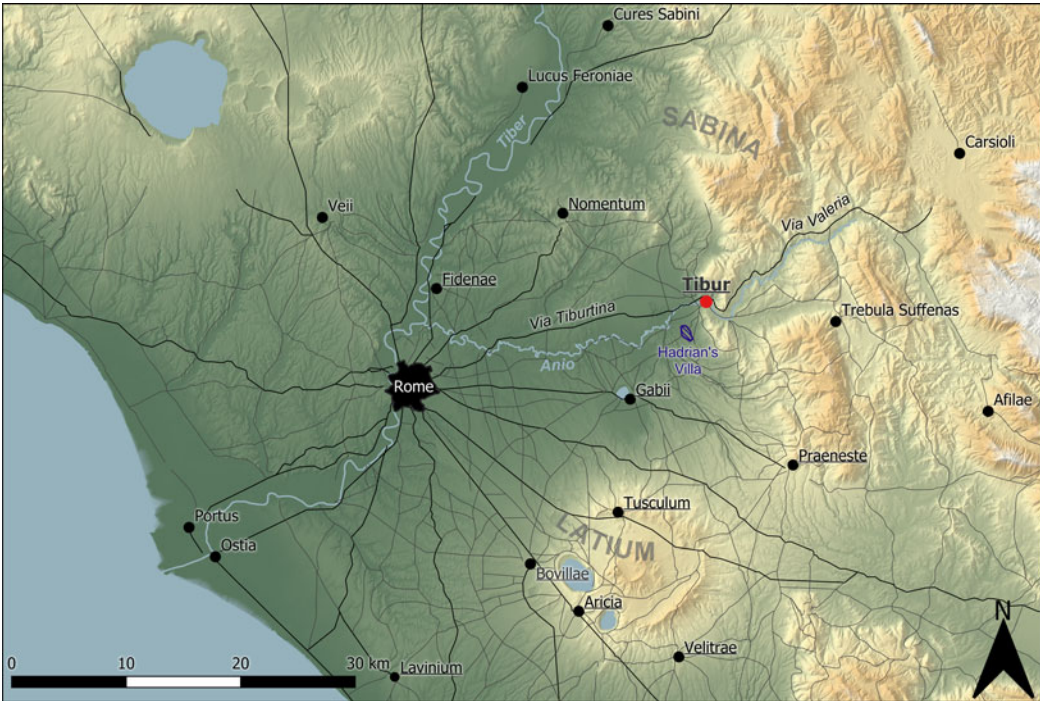


Fig. 2. *Tibur and the Roman suburbium*. Underlined cities indicate those designated suburbanus in written sources. (M. Notarian.)

### Tibur and Rome's suburbium

Tibur had long been a liminal city, straddling various geographical, cultural, and economic boundaries (Fig. 2), but this ambiguity came to challenge its urban identity by the Early Imperial period. It was alternately considered Latin or Sabine.<sup>30</sup> Geographically, it occupied a strategic position along the Anio (modern Aniene) River where the Monti Tiburtini yield to the Roman Campagna's lowlands, producing the city's characteristic waterfalls. It had remained one of the largest independent Latin city-states until the Social War, when it became a municipium (ca. 90 BCE), naturally retaining its own councils, magistrates, and local self-governance.<sup>31</sup> Despite this nominal autonomy, its assimilation into Roman social and economic networks intensified through time. With easy access from Rome along the Via Tiburtina, Tibur continued to be among the most preferred locations for opulent villas belonging to the Roman aristocracy throughout the Late Republic and Empire, offering views across Latium, forests, waterfalls, and access to four urban aqueducts.<sup>32</sup>

<sup>30</sup> Tibur's territory was split between Latium and Sabinum, hence Catullus on his Tiburtine estate (*seu Sabine seu Tiburs* [44.1–6]). It was included in Augustan *regio IV* (Samnium) not *regio I* with Latium (Plin. *HN* 3.107). This uncertainty extends to prehistory: see Fulminante 2014, 41–42 and Bourne 1916, 15–18.

<sup>31</sup> App. *B Civ.* 1.65.

<sup>32</sup> Aqua Anio Vetus, Aqua Marcia, Aqua Claudia, and Aqua Anio Novus. Frontinus (*Aq.* 6.5) mentions a dedicated line of the Anio Vetus for Tibur. All four urban aqueducts considered the needs of Tibur and its surrounding villas (Evans 1993).

## Measuring the visual impact of Tibur's amphitheater

Imperial Tibur's character had been transformed in comparison to its former independence. Florus, for example, recalling its involvement in the Latin War, terms the city "now suburban" (1.5.7: *Tibur, nunc suburbanum*), underlining the contrast between its historical sovereignty and current (2nd-c. CE) cultural dependency.<sup>33</sup> The adjective *suburbanus* was used almost exclusively in reference to Rome's hinterland and applied most frequently to aristocratic villas.<sup>34</sup> Thus the term refers not just to physical proximity to the city, but also to the lifestyle of the metropolitan elite. Rome's ruling classes characterized the cities and towns labelled *suburbanus* primarily as places of *otium*.<sup>35</sup> Their very identity, at least among the villa-owning classes, had become inextricably tied to the surrounding estates in their territories. These settlements were woven into the urban elite's social and economic fabric and formed an extension of Rome's networks, even though they remained administratively autonomous.

Modern scholarship has adopted the noun *suburbium*, although rarely used in antiquity, to denote this ambiguous zone surrounding Rome.<sup>36</sup> Its limits were never clearly defined but nonetheless shifted in response to economic and political forces emanating from the capital, much as Rome's own urban boundaries (e.g., walls, *pomerium*, customs circuit) were continuously redefined through centuries of development.<sup>37</sup> Early Imperial Rome had long since expanded beyond its Republican (Servian) walls, rendering it an "open city."<sup>38</sup> As a result, jurists devised the terms *continentia tecta* or *continentia aedificia* ("continuous buildings") to describe the sprawling extent of "urbanized" extramural structures.<sup>39</sup> Contemporary authors often commented on the difficulty in discerning the boundaries between the *urbs* proper and the countryside beyond. Dionysius remarked the two were so interconnected that Rome appeared to be a "city stretching out indefinitely."<sup>40</sup> Aelius Aristides said Rome spread so far into the surrounding plains and mountains that it was impossible to view its full extent from a single point.<sup>41</sup> This extension had, rhetorically if not literally, begun to touch upon neighboring cities' territories; Pliny the Elder, commenting on Rome's expansion beyond its walls, noted, its "spreading buildings have

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<sup>33</sup> On Florus's floruit, see Baldwin 1988, 139–42.

<sup>34</sup> Champlin 1982; Goodman 2007, 20–28. It usually referred to private property, particularly *villa*, *praedium*, *fundus*, or *rus*. The substantives *suburbanum* (*praedium* understood) and *suburbana* (*villa*) occurred regularly. The noun *suburbium* also existed but was exceedingly rare (see n. 36).

<sup>35</sup> On average within 35 km from Rome, but heavily biased east and south of the Tiber (i.e., Latium, roughly equivalent to the Roman Campagna). Antium (50 km) is an outlier. Notably, not every town therein was *suburbanus*, as it indicated not just physical location but villa culture (Goodman 2007, 20–22; Champlin 1982, 98).

<sup>36</sup> Cicero (*Phil.* 12.24.2); scholia *ad Iuvenalem* (4.7) (Champlin 1982, 97 n. 2). See Quilici 1974; Champlin 1982; Morley 1996; Witcher 2005; Witcher 2006; Witcher 2013; Goodman 2007; Goodman 2016; Emmerson 2020, among others.

<sup>37</sup> Patterson 2000, 95–97; Goodman 2018.

<sup>38</sup> Dey 2011, 161–63.

<sup>39</sup> Goodman 2007, 13–18, 46–49. Its limit is uncertain, as in antiquity. The 14 Augustan *regiones*, whose outer bounds extended beyond the later Aurelian wall, may indicate its extent between 7 BC and 6 CE when established. Whether these were likewise fluid, later expanding, is an open question. See Platner-Ashby 444–48; Robinson 1992, 9–13; Patterson 2000, 90; Goodman 2018, 80; Mandich 2019.

<sup>40</sup> Dion. Hal. *Ant. Rom.* 4.13.4: εἰς ἄπειρον ἐκμηκνομένης πόλεως.

<sup>41</sup> Aristid. *Or.* 26.6.

added many cities.”<sup>42</sup> Moreover, in addition to Rome’s continual growth and the fluid boundaries of city and suburbium, there was a constant alternating flow of people, animals, and goods between Rome and its environs.<sup>43</sup>

Archaeological evidence has made clear that the suburbium was not ordinary “country-side” but an extraordinarily densely occupied region unlike any other in the Roman world. Witcher’s heuristic demographic model of the Early Imperial (ca. 27 BCE – CE 100) suburbium, based on survey data, calculated minimum and maximum populations of ca. 193,000 (35.7 per km<sup>2</sup>) and 644,000 (119 per km<sup>2</sup>), respectively, within 50 km of Rome. His informed estimate falls a little under a third of a million people (60 per km<sup>2</sup>) – almost half to a third of Rome’s own population.<sup>44</sup> This includes the many suburban cities, villages, and other settlements within this zone, which comprise about 32% of the total regional population. The model therefore implies that 68% of the suburban population, or about a quarter of a million people, may have lived between Rome and these larger population centers. Even allowing for a ca. 13% reduction, as suggested by recent archaeological ground truthing of survey data in central Italy, the suburbium was an unusually thickly inhabited landscape that defied simplistic urban–rural dichotomies.<sup>45</sup> Suburban cities needed to visually reify their urban status or risk being absorbed into sprawl.

### **Amphitheaters and the Roman urban image**

Amphitheaters were a late and irregular addition to the suite of amenities typically found in Roman cities. Their earliest and densest spread occurred in the Italian peninsula. After a gradual start in the 1st c. BCE, the 1st and early 2nd c. CE saw a flood of construction, attesting to a shared cultural network and competitive civic spirit.<sup>46</sup> This defies the overall public building pattern in Italy that saw a marked decline after the Julio-Claudian period, except for certain structural types, amphitheaters included, as well as baths and *macella*.<sup>47</sup> Where constructed, amphitheaters became a dominating presence in the urban landscape. Their tall and wide façades towered over most other civic buildings.<sup>48</sup> As a result, they became particularly potent symbols of Roman urban life, as seen in their frequent use in visual culture. The largest and most monumental structures became familiar icons for their cities, such as Puteoli’s Flavian-era amphitheater, which appeared on glass flasks depicting its cityscape.<sup>49</sup> Moreover, two scenes on Trajan’s column prominently display arenas.<sup>50</sup> These clearly distinguish the familiar civilized imperial cityscape from barbarian Dacian settlements.<sup>51</sup> A Pompeian fresco depicting Daedalus and

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<sup>42</sup> Plin. *HN* 3.67: *exspatiantia tecta multas addidere urbes*.

<sup>43</sup> Witcher 2005, 122–24.

<sup>44</sup> Witcher 2005, 124–132; Witcher 2008, 283. Rome’s Early Imperial population is commonly estimated at 850,000 to a million (Morley 1996, 33–39).

<sup>45</sup> Bowes et al. 2020, 466–69.

<sup>46</sup> Laurence et al. 2011, 263–68, 279–82; Patterson 2006, 125–48.

<sup>47</sup> Jouffroy 1986; Lomas 1997; Lomas 2003, 33–37; Patterson 2006, 125–30.

<sup>48</sup> Hopkins 1983, 2; Zanker 2000, 37–38.

<sup>49</sup> Popkin 2018. In two cases, the amphitheater occupies two registers, perhaps accentuating its height.

<sup>50</sup> Scenes 33 and 100.

<sup>51</sup> Wolfram Thill 2010, 36; Futrell 1997, 89–91.





Fig. 3. *Daedalus and Icarus before a walled city containing an amphitheater, Pompeii.* (British Museum 1867,0508.1355, © The Trustees of the British Museum.)

Icarus inserts a conspicuous amphitheater into a distant, generic walled city (Fig. 3).<sup>52</sup> Yet, as in reality, many artistic depictions of cityscapes did not include amphitheaters, instead focusing upon fortifications, gates, or other urban features such as theaters, streets, and houses.<sup>53</sup> Only about a quarter of cities in Italy had a permanent amphitheater.<sup>54</sup> Amphitheaters, then, must have represented a distinctive choice made by civic benefactors and officials, but still one that came to represent, by the 1st c., a prosperous and characteristically urban ideology. The varied depictions of urban forms in Roman visual media confirm the uniformity of the Roman “idea” of a city.<sup>55</sup> With their shared architectural vocabulary, any combination of structures would immediately signify a city to a viewer.<sup>56</sup> Yet, amphitheaters always constituted an exceptional urban form due to their visual dominance and propensity to be situated outside civic centers, which rendered them especially powerful signifiers of urban identity in the Roman world.

<sup>52</sup> British Museum: 1867, 0508.1355.

<sup>53</sup> Goodman 2006, 28–37.

<sup>54</sup> Calculated using Heath’s amphitheater database (<https://github.com/roman-amphitheaters/roman-amphitheaters>) (n=96 excluding cities with multiple structures and private examples). The number of cities in Roman Italy is debatable: Laurence et al. (2011, 263), 460 cities, produces 21%; Hanson’s (2016) catalogue, 335 cities, produces 29%. An unknown number of amphitheaters remain undiscovered.

<sup>55</sup> Roman writers emphasized physical features of the city (Lomas 1997, 22–24).

<sup>56</sup> Favro 2006, 21–30.

## Extramural amphitheaters in Italy

Almost two-thirds of Italy's amphitheaters, including Tibur's, were built in extramural districts.<sup>57</sup> Locating an amphitheater in a suburban zone created several advantages.<sup>58</sup> Logistically, peri-urban neighborhoods offered more space than was available in crowded civic centers developed in previous centuries.<sup>59</sup> They facilitated the movement of raw materials and workers during construction along established road networks, and similarly eased crowd flows on game days, especially from neighboring communities.<sup>60</sup> Moreover, placing these structures beyond the city center offered better event safety.<sup>61</sup> The famous 59 CE riot in Pompeii's amphitheater or the Spartacus revolt underline these spectacles' inherent dangers, which could arise from the spectators, animals, or gladiators themselves.<sup>62</sup> Yet, an extramural location also served several ideological needs. Seventy-eight percent of Italy's amphitheaters were placed along consular highways, which frequently merge into principal urban arteries.<sup>63</sup> Many have their widest major axis oriented along these thoroughfares, emphasizing their monumentality.<sup>64</sup> Proximity to roadside tombs, especially those with integrated seating, would have presented stopping points for travelers from which to view them.<sup>65</sup> These factors amplified their visibility to outsiders, even those who may have bypassed city centers using external ring roads, thus accentuating the city's regional standing without any need to even pass through a gate.<sup>66</sup> Finally, building a monumental venue outside the urban core created opportunities for festival processions to move between theaters, fora, temples, and amphitheaters, integrating extramural growth into the ritualized civic landscape.<sup>67</sup> That amphitheaters were often foci of civic pride is highlighted by an incident during the 69 CE civil war between Otho and Vitellius in which Placentia's suburban amphitheater burned down.<sup>68</sup> Convinced of their neighbors' jealousy, Placentia's inhabitants suspected sabotage rather than a battle casualty.

## Practical benefits of spectacle

Ideology aside, there were also practical reasons for Imperial Tibur to add a permanent arena. Although the benefactors' primary motivations likely lay in the realm of enhancing their political and social prestige, the construction of Tibur's amphitheater

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<sup>57</sup> Bonetto 2003, 926 (using Tosi 2003). Others report lower ratios but are based on smaller samples (Emmerson 2020, 163 n. 2).

<sup>58</sup> For a more thorough discussion and case studies, see Emmerson 2020, 163–95.

<sup>59</sup> Emmerson 2020, 163; Goodman 2016, 316–17; Goodman 2007, 71; Laurence et al. 2011, 266–79; Zanker 2000, 37–40

<sup>60</sup> Bonetto 2003, 927–29.

<sup>61</sup> Zanker 2000, 39.

<sup>62</sup> Pompeii: Tac. *Ann.* 14.17. The Spartacus War began in a gladiatorial school outside Capua, a potent reminder of the danger gladiators posed to public safety (Plut. *Vit. Crass.* 8; App. *B Civ.* 1.14.116). In 64 CE, an attempted revolt by gladiators at Praeneste was quickly suppressed by soldiers stationed to guard them (Tac. *Ann.* 15.46).

<sup>63</sup> Goodman 2007, 71; Bonetto 2003, 926, 936–37; Zanker 2000, 39.

<sup>64</sup> Goodman 2016, 318–19.

<sup>65</sup> Emmerson 2020, 164, 193.

<sup>66</sup> Emmerson 2020, 164.

<sup>67</sup> Emmerson 2020, 165–71; Laurence et al. 2011, 282–83; Bonetto 2003, 929–30.

<sup>68</sup> Tac. *Hist.* 2.21.

opportunistically exploited a dense but dispersed population. As a smaller node in the wider suburbium, Tibur's gravitational pull was unmistakably less powerful than the capital's. Civic leaders may have actively sought ways to bring people into the city rather than Rome. Spectacles in a newly constructed amphitheater may have provided an added impetus for the surrounding populace to travel into the civic center, at least on an intermittent basis, augmenting the social capital of the donors and the status of their city. This would also have the secondary effect of spreading economic benefits throughout the community. Any resulting financial gains may have strengthened already existing ties of patronage with professional associations, such as that of Tibur's builders (*collegium fabrum Tiburtinum*), or cultivated new bonds, perhaps directly providing markets for landowners to sell produce and goods, all of which in turn reinforced the benefactors' social objectives.<sup>69</sup>

Unfortunately, there is meagre documentation of *munera* at Tibur that might provide a sense of the scale, grandeur, or frequency of local events. The sole surviving account mentions a *munus* of 20 pairs of gladiators and an associated *venatio* given in 184 CE by M. Lurius Lucretianus to celebrate his assumption of the civic office of *quinquennalis*.<sup>70</sup> The number of gladiators is fairly mediocre in comparison to data from elsewhere.<sup>71</sup> Another *munus* might be inferred from the inscription of M. Tullius Blaesus discussed earlier.<sup>72</sup> It mentions money spent "towards the dedication of the amphitheater" (*ad amphitheatri dedicationem*).<sup>73</sup> This might have entailed an opening festival, similar to (but undoubtedly far less extravagant than) that which Titus offered to celebrate the Colosseum's inauguration in 80 CE.<sup>74</sup> The omission of a *munus* or *venatio* would be unexpected given donors' propensity to flaunt these gifts on public monuments. The reference to the amphitheater's dedication, however, is tangential to the main dedicatee. In any case, there were certainly more than these two events held in Tibur.

Comparative evidence from other Italian and provincial cities provides an idea of the frequency of spectacles. The surviving municipal charters indicate civic magistrates were required to give a certain number of game days per year using a mixture of public and private funding, although these regular performances are less likely to be commemorated epigraphically than acts of public euergetism, such as the above games of Lucretianus.<sup>75</sup> The *lex Coloniae Genetivae Iuliae* specifies *duoviri* should arrange four days of gladiatorial or theatrical performances a year, and aediles should organize three days of gladiatorial or theatrical spectacles for Jupiter, Juno, and Minerva, plus an additional day of gladiators or chariot races for Venus.<sup>76</sup> The *lex municipii Tarentini* also makes clear the *quattuorviri* were required to hold public games each year, although the extant sections do not detail

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<sup>69</sup> CIL XIV, 3643 = *Inscr. Ital.* IV 149 = ILS 6235.

<sup>70</sup> CIL XIV 3663 = *Inscr. Ital.* IV 192 = ILS 6234.

<sup>71</sup> Notices from painted *edicta* at Pompeii mention 20 to 49 pairs at various Campanian cities (Cooley and Cooley 2014, 290–91). Twenty pairs seem "standard" (Benefiel 2016, 450).

<sup>72</sup> See n. 10 above.

<sup>73</sup> CIL XIV 4259 = *Inscr. Ital.* IV 202 = ILS 5630.

<sup>74</sup> Cass. Dio 66.25; Suetonius (*Tit.* 7.3) uses the related verb *dedico* to describe the events.

<sup>75</sup> Carter and Edmondson 2015, 544. Lucretianus offered games *sua pecunia* and the local council reciprocated with a statue.

<sup>76</sup> CIL II<sup>2</sup>/5 1022 = CIL II Suppl. 5439: 70–71.

their frequency.<sup>77</sup> Other public officials, particularly those associated with the imperial cult, were also obligated to provide gladiatorial shows.<sup>78</sup> A Tiburtine *flamen Augustalis* is attested epigraphically, although without any connection to public spectacles.<sup>79</sup> The most plentiful spectacle record outside Rome comes from Pompeii, where a corpus of painted advertisements (the so-called *edicta munerum*), many of which record monthly dates, supplement the inscribed evidence. Unfortunately, it is impossible to determine in what year many took place. Those that can be dated span a range of some 70 years between the Augustan and Flavian eras.<sup>80</sup> Nonetheless, the clustering of events within a relatively limited group of months seems to indicate a typical year in a middling Italian city might see only a handful of spectacles, perhaps one or two, offered.<sup>81</sup> Moreover, municipal charters and other epigraphic evidence make clear that magistrates had the right to offer other events or public benefactions in lieu of the annual *munera*, so even these may not have taken place with regularity.<sup>82</sup> In short, gladiatorial spectacles were expensive and rare events. They were also immensely popular.<sup>83</sup> Any public official able to pay for a performance was guaranteed a crowd and the grateful appreciation of not only his own townspeople, but a sizeable contingent from the surrounding region, as well.<sup>84</sup>

The apparent regional popularity of gladiatorial events is explained by their scarcity. Several examples illustrate their power to draw in spectators from surrounding towns, even in proximity to Rome. Pompeii's amphitheater, with a capacity of 20,000, likely close to double the city's population, is exemplary. The notorious 59 CE riot between Pompeians and neighboring Nucernians reminds us that sizable contingents came from nearby communities on game days.<sup>85</sup> Moreover, painted advertisements were displayed in and around Pompeii for spectacles in as many as nine surrounding Campanian cities,

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<sup>77</sup> CIL I<sup>2</sup> 590 = ILS 6086. Half of magistrates' fines went towards either the required public games or a public building project: *dimidium in l[u]ldeis quos / publice in eo magistratu facie[t]* ("half towards the games which he will give publicly in that magistracy").

<sup>78</sup> E.g., D. Lucretius Satrius Valens, *flamen* of Nero Caesar at Pompeii, gave 20 gladiator pairs sometime between 50 and 54 CE (CIL IV 3884 = ILS 5154).

<sup>79</sup> CIL XIV 3590 = *Inscr. Ital.* IV 101.

<sup>80</sup> Tuck 2008/2009, 125–27.

<sup>81</sup> Twenty-four known *edicta* advertise games at Pompeii (excluding external events) for which a month is preserved or reconstructed. April and May have the most (five and six, respectively), followed by June and November (three each). September, October, and December have none (Tuck 2008/2009, 127). A more cautious estimate of bi-monthly distribution by number of game days (Cooley and Cooley 2014, 68) shows peaks in the second half of March (4), first half of April (8), first half of May (10), and second half of November (11).

<sup>82</sup> E.g., the Tarentum regulations indicate that fine money could be directed towards another public monument of the magistrate's choosing: *seive ad monumentum suom / in publico consumere volet, l[icet]o*. The *lex Coloniae Genetivae Iuliae* allows magistrates to choose either gladiatorial or theatrical performances. Several Pompeiian inscriptions attest to benefactions made "instead of games" (*pro ludis*: CIL X 845; CIL X 853–57. CIL X 829 is more explicit: *ex ea pecunia quod eos e lege in ludos aut in monumento consumere oportuit*).

<sup>83</sup> Fagan 2014.

<sup>84</sup> Benefiel 2016, 451–53. Even the leading donors at Pompeii may only have offered one to three shows across their entire careers. Gladiatorial spectacles were "always something special" (Hopkins 1983, 7).

<sup>85</sup> Tac. *Ann.* 14.17.

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some as far as 64 km away – a two-day journey by foot.<sup>86</sup> The “away” games advertised at Pompeii tend to extend over three to five days, suggesting longer spectacles might have been used to entice outside visitors.<sup>87</sup> Another infamous incident occurred at Fidenae, only 9 km north of Rome, in 27 CE, during Tiberius's reign.<sup>88</sup> A freedman opportunistically erected a temporary wooden amphitheater, taking advantage of a dearth of shows in Rome itself, which collapsed when 20,000 to 50,000 people came from the capital.<sup>89</sup> Steven Tuck has also argued amphitheater event scheduling at Pompeii reflects a reluctance to overlap with games and festivals in neighboring communities, even as far away as Rome.<sup>90</sup> This strongly indicates a certain segment of the population would have traveled from Campania to Rome for major *ludi* such as the *Ceriales* in April, the *Apollinares* and *Victoriae Caesaris* in July, the *ludi Romani* in September, and the Plebeian Games in November. Moreover, the games of Apollo, the Roman games, and the Plebeian Games were immediately followed by major multi-day market fairs in Rome, indicated separately on various *fasti*.<sup>91</sup>

Tibur's amphitheater could only have accommodated a small number of additional people beyond those who lived in the civic center. Considering, however, amphitheater size as a ratio of urban population, local inhabitants had a much greater opportunity to attend these events than the larger, and potentially more frequent, shows staged in Rome. The structure in Tibur could host its entire urban population, whereas the Colosseum could only host around 5–7% of the capital's, not including the suburban population or other visitors.<sup>92</sup> However infrequent Tibur's spectacles may have been, it was easier for local inhabitants to attend them than Rome's imperially sponsored displays. From this perspective, the amphitheater fulfilled an urban need for social cohesion, and the construction and reification of local social hierarchies that spectacles fostered, which could never be realized by the imperial games staged nearby in the capital.

Despite its modest size, there is no reason to cap event attendance at the amphitheater's capacity.<sup>93</sup> The incident at Fidenae makes clear more people arrived than the temporary structure could safely accommodate. Moreover, Tacitus indicates the casualties included some who were near the amphitheater, not only those who were inside when it collapsed.<sup>94</sup> The blame for this catastrophe, as Tacitus explains, fell partly on Tiberius's shoulders

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<sup>86</sup> Atella, Capua, Cumae, Forum Popillii, Herculaneum, Nuceria, Nola, Puteoli, and possibly Cales. See Tuck (2008/2009) and Benefiel (2016, 446–56) for discussion. Hanson and Ortman (2020, 419) calculated distances, noting most fall within one day's journey. Benefiel (2016, 455) puts Forum Popillii 80 km away (a two-day journey), possibly following the coastal road network versus linear distance.

<sup>87</sup> Benefiel 2016, 450.

<sup>88</sup> Tac. *Ann.* 4.62–3; Suet. *Tib.* 40.

<sup>89</sup> Higher figure, Tacitus; lower, Suetonius.

<sup>90</sup> Tuck 2008/2009.

<sup>91</sup> Frayn 1993, 134–35; De Ligt 1993, 60.

<sup>92</sup> Hanson and Ortman 2020, 432–34, appendix table 2. They estimate Tibur's population at 6,767 based on an area of 45 ha. I calculate 39.5 ha, which results in 5,685 people (144 per ha) using their (2017, 317, fig. 3) regression equation.

<sup>93</sup> Hanson and Ortman 2020, 426.

<sup>94</sup> Tac. *Ann.* 62: *spectaculo intentos aut qui circum adstabant* (“those watching the spectacle or those who were standing around”).

because it was his supposed lack of public entertainment in Rome that led the urban populace, desperate for recreation, to the suburbs. This is likely exaggerated for polemic effect. Rather, the tremendous population of Rome and its suburbium, combined with the infrequency of gladiatorial shows, probably accounts for the excess attendance. Any spectacle within this zone would have attracted vast crowds. Therefore, Tibur's location gave the city the potential to easily attract thousands of people for its spectacles, drawing both from the immense local population and from travelers heading to Rome along the Via Tiburtina–Valeria corridor. The city could theoretically have timed events to avoid major festivals at Rome, as at Pompeii, or perhaps strategically staged them to take advantage of an increase in traffic before or after these dates. Assuming people were willing to travel a full day to attend a spectacle (about 40 km according to John Hanson and Scott Ortman, extrapolating from Pompeiian painted advertisements), the entire population of Rome and its eastern suburbium were within the city's catchment area – a figure of well over a million people.<sup>95</sup> While not everyone could have been seated for the main event, the festival atmosphere of games probably meant there was alternative entertainment, not to mention plenty of money-making opportunities that augmented the reciprocal ties between patrons and local *collegia*. Typical games featured events in the days leading up to the actual spectacle, including a public presentation of the gladiators, a banquet, and a procession (*pompa*).<sup>96</sup> One such parade, depicted on a tomb relief from Pompeii, shows the sponsor among various lictors, attendees, and horses, carrying musical instruments, arms and armor, and statues borne on litters.<sup>97</sup>

Merchants certainly took advantage of the crowds that gathered in and around the amphitheater during games. There is, in fact, direct evidence for this in the well-known riot painting found in the House of Actius Anicetus (I.3.23) in Pompeii. Temporary stalls with fabric awnings are visible in the open area in front of the amphitheater. Moreover, painted notices within the amphitheater's actual exterior arches indicate specific merchants had the aediles' approval to utilize these locations for selling goods.<sup>98</sup> Clearly these were coveted spots for market stalls that required civic authorities to adjudicate, perhaps through the intercession of elite patronage. Similar evidence might be seen in a Late Antique graffito from a niche on the exterior wall of Aphrodisias's theater listing prices of foodstuffs, as well as several nearby inscriptions possibly indicating spots reserved for out-of-town merchants.<sup>99</sup> Other evidence for the commercialization of amphitheater games has been inferred from a variety of portable objects decorated with gladiatorial and animal hunting scenes, such as lamps, figurines, bowls, and glass cups.<sup>100</sup> The fact that some glasses, for example, contain well-known gladiators' names has been interpreted

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<sup>95</sup> Hanson and Ortman 2020, 427, although their estimate for Tibur's region (965,685: appendix table 2) only includes urban populations, omitting intercity suburban inhabitants.

<sup>96</sup> Junkelman 2000, 64–65; Fagan 2014, 468; Tert. *De spect.* 7.2–3; Ps.-Quint. *Declamationes Maiores* 9.6.

<sup>97</sup> From an unknown tomb. Now in the Museo Archeologico Nazionale di Napoli (no. 6704).

<sup>98</sup> *CIL* IV 1096 = *ILS* 5291a; *CIL* IV 1096a–1097b, 2485.

<sup>99</sup> Lavan 2012, 339–41. The food list (Roueché 2004, no. 213) could indicate a market stall selling honey, wine, oil, bread, and various vegetables and grains. The *topos* inscriptions (Roueché 2004, nos. 196–97) on the Tetrastoon columns indicate reservations for “men of Hierapolis.”

<sup>100</sup> Benefiel 2016, 446.

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as evidence these objects were sold as souvenirs of actual events.<sup>101</sup> They have often been compared to the fictional silver cups depicting Trimalchio's favorite gladiators.<sup>102</sup> Local artisans around the empire also capitalized on famous monuments by selling souvenir trinkets, such as the silver models of the Temple of Artemis at Ephesus, ceramic replicas of the Aphrodite of Knidos, and glass flasks engraved with scenes of Puteoli and Baiae.<sup>103</sup> If the interpretation of such objects as souvenirs is correct, one would assume the bustling marketplaces surrounding Roman cities' amphitheaters were one place where they were peddled. Indeed, any public event that attracted large crowds, from games to periodic courts, provided opportunities for peddlers, poets, orators, and other entertainers to ply their trades, bringing economic benefit to the city.<sup>104</sup>

The spectacles themselves also must have required a great deal of human labor. The amphitheater, in addition to regular maintenance, needed to be prepared and decorated. The awning (*velarium*), if available, needed to be raised. Advertisements needed to be painted around town and nearby cities, and programs (*libelli*) distributed. Props, sets, costumes, weapons, and armor needed to be made, procured, transported, and staged. Animals had to be purchased, delivered, fed, and ultimately displayed and disposed of. A staff would have been necessary to maintain crowd control before, during, and after the shows, and a herald was required to officiate. Games provided a range of direct and indirect benefits to the local economy. Moreover, there may have been the opportunity to directly profit by charging some spectators, perhaps non-residents, fees for admission, as the disaster at Fidenae attests.<sup>105</sup>

### Visibility of Tibur's amphitheater in the suburban landscape

Nonetheless, a purpose-built permanent structure was not required to host local spectacles. Presumably, Tibur, like most communities in the empire, had formerly been holding both donated and requisite annual public games either in temporary wooden structures or in another public venue, such as the sanctuary of Hercules Victor's theater.<sup>106</sup> The amphitheater's significance therefore cannot be attributed to mere economic expectations alone, although these could have factored into the decision to authorize its construction. A larger structure with a higher seating capacity would have capitalized better on its geographic advantages. However, given the steady erosion of Tibur's urban identity, its donors may have primarily intended to reassert civic centrality while at the same time delicately

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<sup>101</sup> Künzl and Koeppl 2002, 20–22; Cassibry (2018, 16), however, notes most examples were found in the northwest provinces, their possible center of manufacture. Relatively few were found in Italy, but these include Rome and surrounding cities (i.e., Alba Fucens, Sentinum [del Vecchio 2001, 25, 28]).

<sup>102</sup> Petron. *Sat.* 52.3.

<sup>103</sup> Popkin 2018, 427–29; Ephesus: Acts 19:24; Knidos: Ps. Lucian, *Affairs of the Heart* 11.

<sup>104</sup> Dio Chrys. *Or.* 8.9 (Isthmian Games); Dio Chrys. *Or.* 35.15–16 (economic benefits of assizes). Also, Boatwright 2000, 98.

<sup>105</sup> Despite Tacitus's (*Ann.* 4.62–63) disapproval of the freedman sponsor's "sordid gain" (*in sordidam mercedem*), the senate did not ban such practices, only limiting sponsors to those with fortunes larger than 400,000 HS. See Chamberland 2007.

<sup>106</sup> Vitruvius (5.1.1–2) relates the rectangular shape of civic *fora* to the wooden seating for gladiatorial *munera*. E.g., though lacking a permanent amphitheater, Forum Popillii advertised a show with 24 pairs in Pompeii (*AE* 1990, 177c; Benefiel 2016, 453).

balancing potential imperial displeasure. The amphitheater's placement just outside the city walls, to the southwest of the urban center, made it especially visible to travelers coming from Rome. The relentless expansion of the *continentia aedificia* and enlargement of elite villas on Tibur's slopes had rendered the city increasingly inconspicuous in the suburbium's landscape. Extramural construction had long since overgrown and obscured the city walls, another important marker of *urbanitas*.<sup>107</sup> A concrete vaulted amphitheater rising above the rooflines of Tibur's civic center, however, was an unambiguous signifier of urbanity.

Tibur's amphitheater was built near the boundary between the suburban district and the city's broader hinterland, as indicated by the proximity of a developed extramural road network with adjacent structures, tombs, villas, and ceramic workshops (Fig. 4).<sup>108</sup> Nevertheless, it was not built on open land. Its northeastern *cavea* covered an earlier basalt paved road, oriented north-northwest, unlike the amphitheater.<sup>109</sup> Moreover, traces of earlier structures were found in space XXV on its east, as well as adjacent to the western exterior foundation.<sup>110</sup> Therefore, we cannot simply ascribe its location to the availability of undeveloped land. Unlike most of Italy's suburban amphitheaters, however, it was not located along the major thoroughfare, the Via Tiburtina-Valeria, that passes well to the north and through the civic center.

The amphitheater's immediate context reveals some key features. It is not oriented with the existing road network. The only extant parallel road is a stretch located about 30 m to its east, uncovered during excavations in the 1990s.<sup>111</sup> The section's connection to the larger street system is unknown, but projecting it northwards, it probably joined one of the subsidiary roads leading to the city's southwest gate. Topography most likely explains the amphitheater's bearing, about 14 degrees. While not parallel to the current steep scarp to the west, the amphitheater is aligned with a villa terrace built into this hillside, suggesting the ancient topography differed.<sup>112</sup> Moreover, by orienting the amphitheater's major axis with the precipice, it minimized the economic benefit of Monte Ripoli's rising terrain for its foundations.<sup>113</sup> Aligning its major axis east to west would have allowed more seating to use the hill for support, but instead the builders chose the opposite orientation, an extremely unusual decision.<sup>114</sup> Its visibility from the west is enhanced, but at the added cost of more building material. Furthermore, the amphitheater was built on some of the

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<sup>107</sup> On the symbolic significance of walls, see n. 53 above; Dey 2011, 116–23; Van der Graaff 2019, 157–69, 198–201; Emmerson 2020, 6–8.

<sup>108</sup> Mostly documented in Giuliani 1970. More recent finds: Mari 1991a, 122–24; Mari 1994, 153–56; Mari 2001, 51–54; Mari and Moschetti 1993, 124–27.

<sup>109</sup> Frontoni 1997, 122–23.

<sup>110</sup> Frontoni 1997, 124; Mari 2002, 187.

<sup>111</sup> Frontoni 1997, 127.

<sup>112</sup> Giuliani 1970, 237–38 n. 136.

<sup>113</sup> Nardelli 2003, 947–53.

<sup>114</sup> E.g., 14 of Golvin's 16 "third construction style" (partially leaning on a hillside) amphitheaters used the natural slope along their longer dimension (Casinum, Castra Albana, Alba Fucens, Tarraco, Segobriga, Segusium, Veleia, Augusta Treverorum, Forum Iulii, Pola, Salona, Vesontio, Syracusae. Golvin 1988, 407; Tanzilli 2004, 97–98). The orientation of the last two could not be confirmed. The opposite, as in Tibur, was very rare (e.g., Dyrrachium [Bowes and Hoti 2003]).



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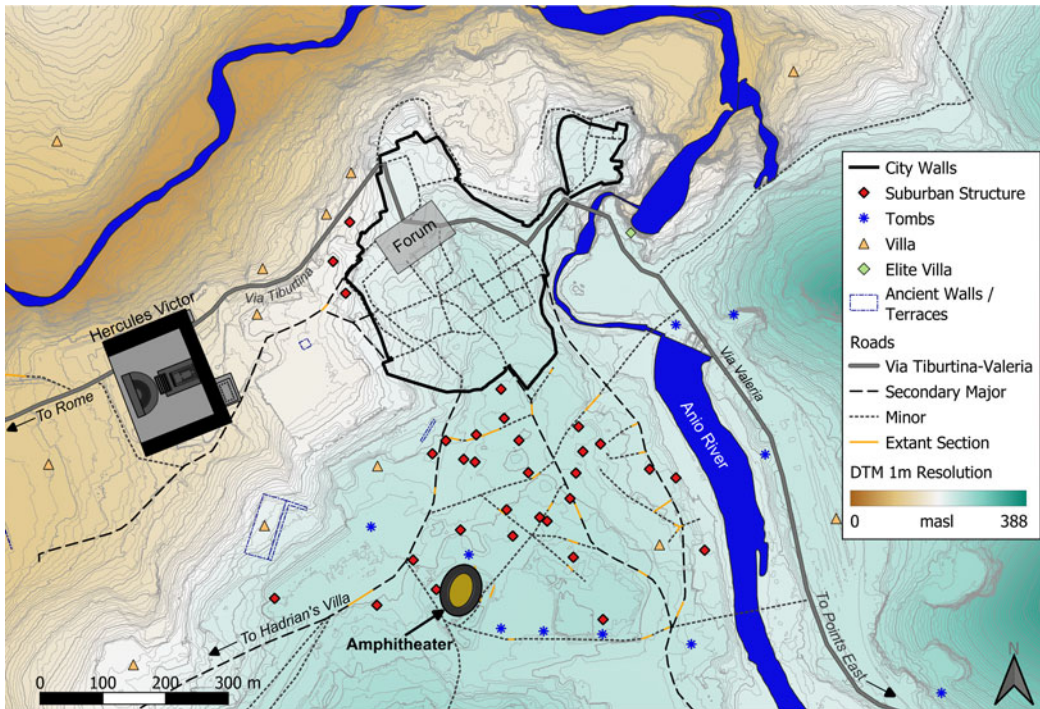


Fig. 4. Tibur: amphitheater and suburban district. 2 m contours. (M. Notarian.)

highest terrain inhabited in that period, rendering it more observable from most directions. In fact, the Rocca Pia used this site for the same reasons in the 15<sup>th</sup> c.<sup>115</sup> While not located along the Via Tiburtina, it profited from major secondary roads. To its west, several routes intersected, forming an alternate path to the city center. Significantly, this offered the most direct route to Hadrian's Villa from the city, as well as to most of the region's largest and most luxurious villas, ranged along Monte Ripoli's western slopes. As it approached Tibur's city gate, it curved to the north, passing the amphitheater's widest façade. Travelers may also have chosen to bypass the city altogether, heading east along the road that likely passed south of the amphitheater, crossing an Anio bridge to reach the Via Valeria. Thus, in addition to the regular flow between Rome and regions to the east, members of the Roman elite, potentially even the emperor, may have passed the amphitheater on their way to or around the civic center.

The amphitheater also served to integrate Tibur's suburban district into its older urban core, and the 1st-c. BCE suburban sanctuary of Hercules Victor. As processions of gladiators, musicians, animals, civic magistrates, and attendants preceded many games, we can imagine these originating in the forum and proceeding along the intramural street network towards one of the southern gates in the amphitheater's direction.<sup>116</sup> Local *iuvenes* organizations, paramilitary youth groups, likely used amphitheatres and theaters for exercises

<sup>115</sup> *Commentaries of Pius II*, 5.26.6: *lecit igitur e vestigio fundamenta in sublimiori urbis loco, ubi veterem fuisse ruinae adhuc extantes indicabant.* ("Therefore, he immediately laid foundations in the higher part of the city, where still extant ruins indicated the old fortress had been.") The visible remains may belong to the amphitheater, converted into a fortress in the 13th c.

<sup>116</sup> See n. 96 above.

and displays, possibly even games, involving animal hunts, fencing, and horseback riding.<sup>117</sup> Tibur's association became affiliated with Hercules by the 2nd c., then acquired a connection with the imperial cult in the Severan period.<sup>118</sup> Its members may have used a processional route that linked the theater within the sanctuary of Hercules to the amphitheater.<sup>119</sup> Due to the local topography, such a procession would have had to pass through the city's monumental center.

The amphitheater's visual impact could have extended well beyond the city's immediate environs. Due to its elevation, Tivoli is often visible from Rome today. Although dependent on atmospheric conditions, Tivoli's white buildings are frequently conspicuous on the horizon from points in Rome. As attested in Augustan and earlier literature, such was the case even in antiquity, when the city covered less area and had no tall apartment buildings. Strabo (5.3.11) lists Tibur, along with Praeneste and Tusculum, as cities "in sight" (ἐν ὄψει) of viewers in the capital. Horace (*Odes* 3.29) alludes to Maecenas on his Esquiline estate longingly looking out at Tibur, likely from his tower.<sup>120</sup> Propertius (3.16.3–4) mentions his lover Cynthia calling him to Tibur from business in Rome, "where white rooftops show twin towers" (*candida qua geminas ostendunt culmina turres*), probably referring to a Tiburtine villa visible from the capital.<sup>121</sup> Cicero (*De or.* 2.263, 2.276) also mockingly describes Metellus Numidicus's Tiburtine villa, which was visible from Rome's Esquiline Gate, criticizing its ostentatious size.

### Methods: visibility analysis

Amphitheaters' visual dominance is often cited as a motivating factor for their placement along road networks, yet this is typically expressed in impressionistic terms rather than through a calculated viewshed.<sup>122</sup> Given the complexity of the terrain surrounding Tibur, visibility analysis permits a more precise measurement of the visual dynamics for travelers moving along these networks. A digital model allows us to interrogate features of the archaeological landscape that no longer exist without the need for a comprehensive reconstruction of all its, largely unrecoverable, aspects.<sup>123</sup> Nevertheless, viewshed analysis is not without limitations and requires an evaluation of several variables to render meaningful results.<sup>124</sup>

<sup>117</sup> Laes and Strubbe 2014, 122–33; Kleijwegt 1994, 85–88; Laurence et al. 2011, 252–58; Patterson 2006, 144–45.

<sup>118</sup> Jaczynowska 1981, 644–45; Giletti 2018, 403–5; *CIL* XIV 3684 = *Inscr. Ital.* IV 220 = *ILS* 6237 (*iuvenes Tiburtium*); *AE* 1956, 77 = *AE* 1958, 177 (*sodalitium iuvenum Herculaneorum*); *CIL* XIV 3638 = *Inscr. Ital.* IV 180 (*iuvenes Antoniniani Herculani*). An inscribed (*ICH – Iuventus collegii Herculanei?*) lead token from near Tibur could have served as a ticket to such games (*Inscr. Ital.* IV 630). See Taylor 1924, 160.

<sup>119</sup> Limited evidence connects *iuvenes* to theatrical performances (Laes and Strubbe 2014, 131).

<sup>120</sup> West 2002, 250.

<sup>121</sup> A villa near the Aniene opposite the city is traditionally identified as Cynthia's (Giuliani 1970, 336–38 n. 212). "White" may allude to the frequent use of travertine, quarried nearby in Aquae Albulae. Also see Heyworth 2007, 370–71.

<sup>122</sup> See n. 63 above.

<sup>123</sup> Llobera 2007.

<sup>124</sup> Sullivan (2020) provides a useful synopsis of recent theory related to 2D, 2.5D and 3D visibility in archaeological landscapes. Only a modest selection is discussed here.

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Table 1.  
Compared amphitheater dimensions (m)

<i>Site</i>	<i>External</i>	<i>Arena</i>
<b>Tibur</b>	83 x 64	57 x 37
<b>Casinum</b>	85 x 69	52 x 36
<b>Tarraco</b>	130 x 102	61.5 x 38.5

First, the amphitheater's original height must be estimated, which is difficult given its poor preservation. By examining better-preserved comparanda of similar size, a feasible range for Tibur's vertical façade can be established (Table 1). Casinum's amphitheater, for example, approximates the external dimensions of Tibur's closely and preserves an 18 m façade at its maximum.<sup>125</sup> Alternatively, virtual reconstructions of Tarraco's larger amphitheater estimate heights of about 15 to 18 m.<sup>126</sup> The size of their arenas, however, varies in proportion to their total footprint, which corresponds to different *cavea* widths. Therefore, applying the seating rake along Tibur's *cavea* width is perhaps a more accurate method, but angles vary between the *ima*, *media*, and *summa cavea*.<sup>127</sup> Furthermore, the external wall rose higher than the top step of the *summa cavea*, and the podium wall height must also be accounted for. Jean-Claude Golvin estimated minimum heights by applying an average *cavea* slope of 35° to *cavea* width, plus the average podium height of 2.63 m, which would suggest Tibur's façade was 12 m tall (13.5 m *cavea* width), not including extra height above the *summa cavea*.<sup>128</sup> Casinum's external wall extends more than 7 m above the *summa cavea*, a substantial height that would be missing if only the average rake of 28° was considered.<sup>129</sup> This method would estimate Casinum's height to be just under 12 m, a cautionary reminder that these figures are indeed minima. Architectural ratios offer yet another method (Table 2). Unfortunately, there are no standard ratios of amphitheater height to other dimensions, such as arena width or major axis length.<sup>130</sup> These vary widely in the best-preserved examples and produce broad variance when applied to Tibur, with improbable maximum heights. Nevertheless, collectively, these figures provide a conservative feasible range for Tibur's original façade elevation: a minimum of 12 and maximum of 18 m.

The underlying Digital Elevation Model's accuracy and resolution also impact visibility analysis. For this study, a 1 m filtered Digital Terrain Model (DTM) from the Ministero dell'ambiente e della tutela del territorio e del mare was used.<sup>131</sup> Derived from LiDAR, this DTM offers high resolution elevation data; however, its current coverage extends only along the Aniene valley, including Tivoli's urban center. TINITALY data, with 10 m

<sup>125</sup> Tosi 2003, 52; Tanzilli 2004, 101.

<sup>126</sup> Buill et al. (2015) estimated 50 Roman feet (14.8 m) from the arena floor. Codina-Peñarroja (2020, 135, fig.12) reconstructed a façade over 18 m in its southern sector.

<sup>127</sup> Slope increases with height: Golvin 1988, 292–95.

<sup>128</sup> Golvin 1988, pl. LIV.2, mistakenly cited 37° average on p. 294. Tibur's podium is only preserved to 1.3 m (Frontoni 1997, 125–26). Calculated by height = width x Tan(35).

<sup>129</sup> Measured from Tanzilli's (2004, 99, fig. 4) reconstructed section and *cavea* block measurements.

<sup>130</sup> Wilson-Jones 1993, 426–29.

<sup>131</sup> García Sánchez 2018; Fontana 2022, 246.

Table 2.  
Architectural ratios for estimating façade height

	<i>Arena width: façade height</i>		<i>Building length: façade height</i>	
<b>Extant structure ratio</b>	Nimes (7:4)	Verona (2:3)	Nimes (1:6)	Verona (1:5)
<b>Resultant Tibur façade height</b>	21.4 m	24.7 m	13.8 m	16.6 m

resolution, encompasses the entire region, and was substituted in zones lacking higher-resolution coverage.<sup>132</sup>

Typically, visibility analysis outputs a simplistic binary viewshed, denoting areas as visible or not visible. This fails to account for several crucial factors, such as the viewed object's size, the observer's visual acuity, lighting and atmospheric conditions, color difference, contrast, shape, and interference from vegetation and other built structures in the landscape.<sup>133</sup> Furthermore, seasonal changes would greatly affect the landscape's background color and the degree of obstruction by leaves. A DTM represents a bare earth surface, devoid of buildings and vegetation, not an accurate reconstruction of the complete ancient landscape. Moreover, in highly urbanized areas of Italy, such as Tivoli, the filtering algorithms used to prepare the data fail to completely remove the anthropogenic impact of terracing, paving, and large building footprints. Various techniques have been developed to account for these uncertainties in visibility analysis, such as probabilistic, fuzzy, or tiered Higuchi viewsheds, which aim to quantify the theoretical potential for visibility through the landscape.<sup>134</sup> These consider inaccuracies in the elevation model, the limits of human vision, and differences in visual acuity between individuals, as well as numerous other factors that impact human perception. Dennis Ogburn, for example, extrapolating from Peter Fisher, defined a fuzzy viewshed by implementing a decay factor (ranging from 1 to 0) to represent the decreased visibility of objects or features in the landscape with increased distance. Many methods are based on visual angle calculations, which are a factor of the viewed object's size and distance from the observer's eyes. Still others have approached the limitations of viewshed analysis by embedding interpretation within more nuanced theoretical frameworks, such as affordances (i.e., the relational possibilities offered by the environment to human agents with varied abilities and culturally mediated knowledge), seeking to directly engage critiques arising within landscape phenomenology.<sup>135</sup>

While not every shortcoming is addressed here, two methods were implemented to account for the amphitheater's apparent visible size in the landscape. An object's apparent visible size is a factor of the most stable variables – distance, height, width, and topography – and can therefore be quantified most reliably. First, given the amphitheater's location near a ridge, it would become progressively obscured by the hillside as a traveler approached the city along the Via Tiburtina, leaving increasingly smaller slivers of its vertical façade visible. A cumulative viewshed was constructed in ArcGIS using 16 points placed along

<sup>132</sup> Tarquini et al. 2007. All subsequent analyses were run on both DTMs with the results clipped to exclude TINITALY data where the 1 m DTM was available.

<sup>133</sup> Ogburn 2006, 406–7; Fábrega-Álvarez and Parcero-Oubiña 2019, 56–57; Verhagen 2018, 18–20; Gillings and Wheatley 2020.

<sup>134</sup> Higuchi 1983; Fisher 1994; Ogburn 2006; Wheatley and Gillings 2000; Llobera 2007; Fábrega-Álvarez and Parcero-Oubiña 2019.

<sup>135</sup> Gillings 2012; Wernke et al. 2017.

## Measuring the visual impact of Tibur's amphitheater

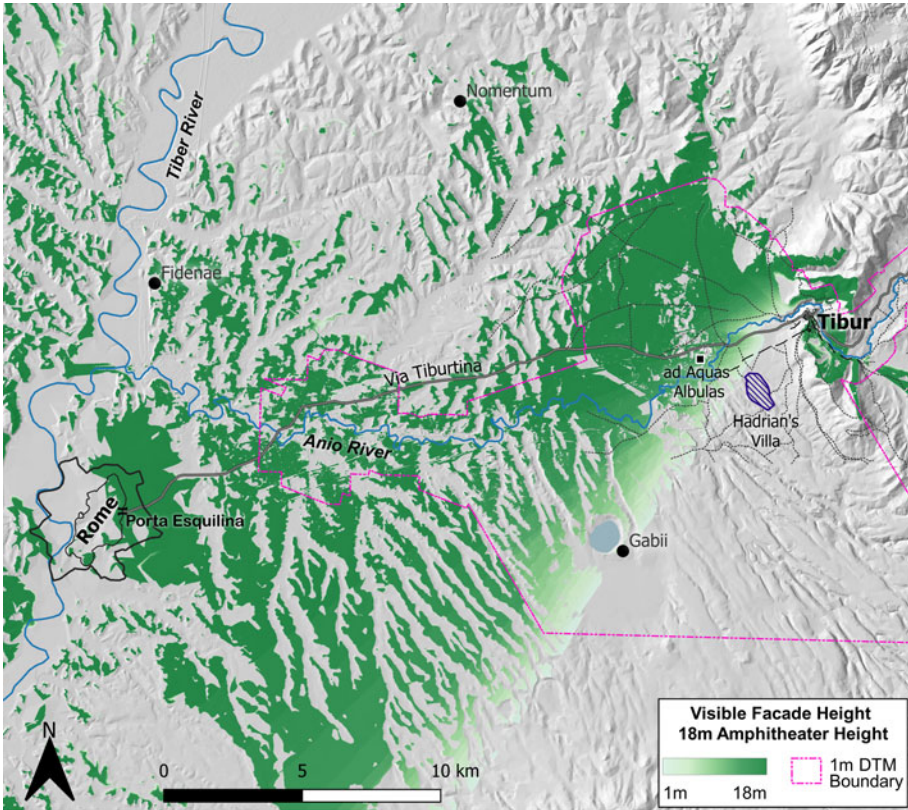


Fig. 5. Visible height of Tibur's amphitheater. 18 m façade. (M. Notarian.)

the amphitheater's perimeter – one at each axis and three equidistant points between these. The cumulative result was binarized to values of 0 or 1 to indicate areas of the landscape in which any amphitheater section was visible. To determine the limits where every meter of its façade disappeared below the hill, the visibility analysis was then iterated using a constant 1.65 m landscape offset to approximate average human height, but amphitheater offsets diminishing by one meter each run, starting from the maximum of 18 m.<sup>136</sup> The resultant viewsheds were summed in a single raster whose value represents the visible amphitheater height in meters (Fig. 5).

For apparent size, rather than using arbitrary scales derived from fuzzy logic or indices based on modified Higuchi viewsheds, the actual visual angles subtended ( $\theta$ ), in both the horizontal and vertical directions, were calculated according to equation (1):

$$\theta = 2 \times \tan^{-1}\left(\frac{(S/2)}{D}\right) \quad (1)$$

where  $S$  is the amphitheater's size in either width or height and  $D$  is its distance from the viewer (Fig. 6A). Vertical angles were calculated using its reconstructed height, factoring in its occlusion by the hillside as in figure 5. Horizontal angles are dependent upon the amphitheater's width, but this varies with the angle viewed. Assuming the amphitheater

<sup>136</sup> With earth curvature and refraction (coefficient: 0.13) corrections activated.

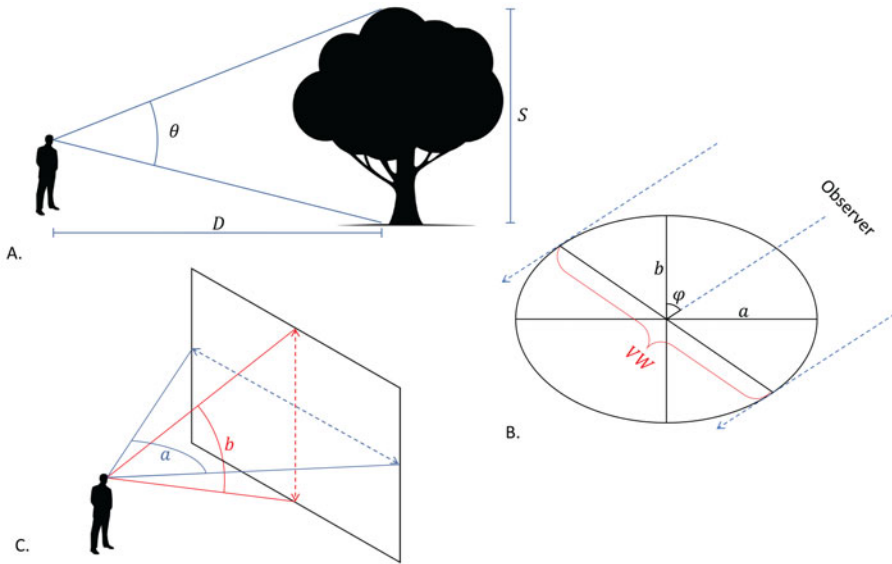


Fig. 6. Visual metrics: (A) visual angle; (B) visible width; (C) solid angle. (M. Notarian.)

was a true ellipse, its visible width (VW) can be calculated as its diameter when seen from any direction using equation (2):

$$VW = 2\sqrt{a^2 \cos^2 \varphi + b^2 \sin^2 \varphi} \quad (2)$$

where  $\varphi$  is the angle relative to the viewer and the amphitheater's minor axis,  $a$  is its semi-major axis length (i.e., half its major axis length), and  $b$  its semi-minor axis length (Fig. 6B). At close distances, the amphitheater's widest façade is only visible at angles near perpendicular to its major axis, however, these fan outwards further away (Fig. 7). Consequently, even at Rome's Esquiline Gate, 79 m of the amphitheater's full width was visible, despite being oriented some  $32^\circ$  away from perpendicular to its major axis. Thus, the amphitheater's orientation quantitatively improves visibility from the west, especially along the Via Tiburtina, while the civic center was on the receiving end of its least expansive aspect.

Visual angles can be related to real world objects at known distances. For example, an individual's thumb held at arm's length is about  $2^\circ$  wide, while the full moon is a quarter of this width (about  $30'$ ). The Colosseum's height viewed from 50 m is about  $52'$ , a significant proportion of an individual's full vertical field of view ( $120$ – $130^\circ$ ).<sup>137</sup> The conventional limit of human vision for an individual with 20/20 eyesight is  $1'$  of visual angle, but this represents minimal discernment under optimal conditions, such as the ability to differentiate the strokes and spaces of the smallest letters on an eye chart, not significant visual dominance. Ogburn's fuzzy viewshed characterized  $1'$  as the cutoff point at which some people could perceive an object in the landscape in perfect circumstances, with a fuzzy value of .33, but even larger angles would push the limits of human vision in the real world. Tibur's amphitheater, assuming its entire façade was white travertine, would contrast well enough with a

<sup>137</sup> Panero and Zelnick 1979; Parsaee et al. 2021, 4–5.

## Measuring the visual impact of Tibur's amphitheater

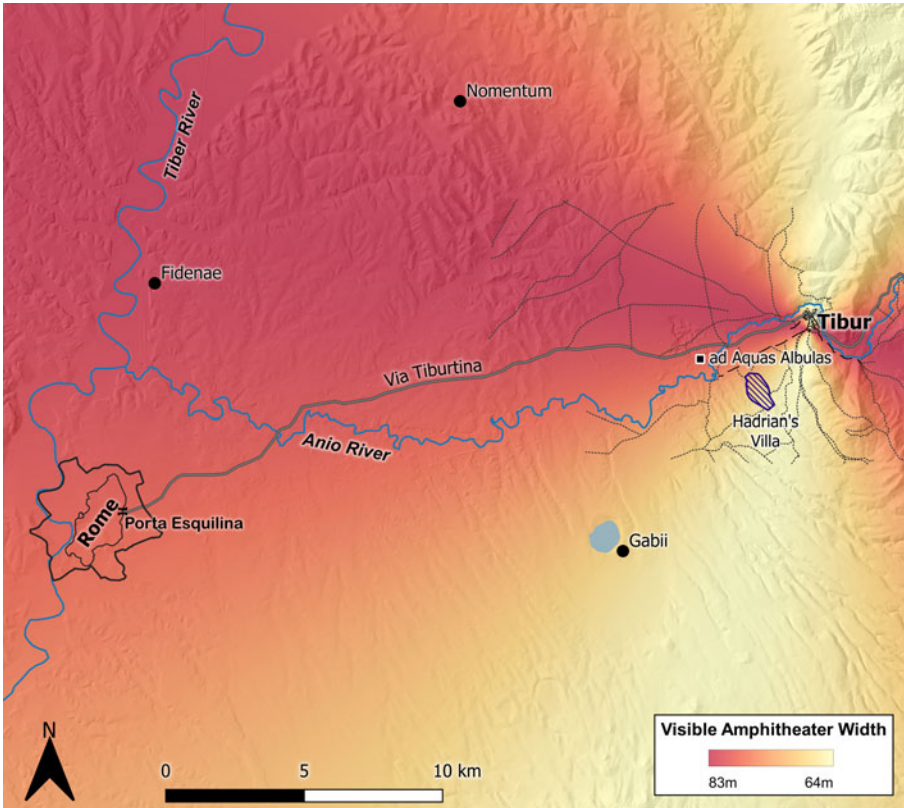


Fig. 7. Visible width of Tibur's amphitheater. (M. Notarian.)

blue sky on a sunny day, but likely blend into a clouded or hazy horizon.<sup>138</sup> Using a fuzzy viewshed, an 18 m-tall façade would be considered potentially visible as far as 61 km away (where it subtends to 1'), which strains credulity. Actual angles facilitate more transparent interpretations of potential visibility, yet varying amphitheater angles in either the horizontal or vertical dimensions complicate this analysis.

Objects can also be measured using a single quantity, solid angle ( $\Omega$ ), that accounts for its total visible surface area in both directions. This was calculated using equation (3).<sup>139</sup>

$$\Omega = 4 \times \sin^{-1} \left( \sin \left( \frac{a}{2} \right) \sin \left( \frac{b}{2} \right) \right) \quad (3)$$

where  $a$  is the amphitheater's horizontal angle subtended (degrees) and  $b$  its vertical angle (degrees), as calculated by equation (1) (Fig. 6C). The output in steradians was converted to square degrees by multiplying by  $(180/\pi)^2$ . This quantity is often referred to as *visual magnitude* – the extent ( $\text{deg}^2$ ) a particular object occupies in the field of view.<sup>140</sup> It is often applied to assess the impact of landscape modifications, such as clearcutting, the

<sup>138</sup> Shang and Bishop (2000) found both contrast (grayscale) and apparent size were important factors in experimental detection and recognition of towers and oil tanks in the landscape.

<sup>139</sup> Parsae et al. 2021, 7.

<sup>140</sup> First defined by Iverson (1985).

placement of wind turbines, telecommunications towers, and other infrastructure, or as a measure of general landscape aesthetics.<sup>141</sup>

Previous studies have sought to define thresholds based on visual angles and visual magnitude for detection and recognition of structures, landforms, and people within the landscape. In controlled image viewing tests, Haidong Shang and Ian Bishop found an object's size, shape, and contrast with its background fundamentally impact the magnitude at which it can be observed.<sup>142</sup> Half or more observers with no prior knowledge of the objects to be spotted (a tower and gas tank) detected them at  $8.5 \text{ min}^2$  (i.e., a fractional unit of solid angle equivalent to  $1/3600$  of  $\text{deg}^2$ ) if there was strong contrast, but required  $48 \text{ min}^2$  under lighter contrast. However, they could only correctly identify them at  $48 \text{ min}^2$  with strong contrast and  $247 \text{ min}^2$  with weak contrast. Observers who were, on the other hand, directed to detect towers and tanks required only  $14 \text{ min}^2$  and  $105 \text{ min}^2$  under high and low contrast, respectively. Interestingly, contrast type was also decisive. Objects that were brighter than their background were detected at much smaller sizes than the opposite, as low as  $5 \text{ min}^2$  for uninformed observers with strong contrast. This suggests the amphitheater's potential detection and recognition in the landscape would have varied depending on atmospheric conditions and season, not to mention an observer's expectation of seeing an amphitheater ornamenting the city.

Pastor Fábrega-Álvarez and César Parcero-Oubiña conducted an empirical field study to determine distances at which human walkers could be not just merely detected but recognized and identified under ideal conditions of weather and contrast (defined as the Individual Distance Viewshed [IDV]).<sup>143</sup> Though based on subjects much smaller than monumental architecture, these thresholds nonetheless provide useful proxies for when fine details of a structure would become apparent to a viewer. First detection, the level at which an unidentified object can be distinguished, occurred between 2550 and 2100 m. Using equation (1) and assuming an individual 1.65 m tall, this subtends to a vertical angle between  $2' 13''$  and  $2' 42''$ , more than the widely cited  $1'$  limit. Human being recognition only occurred at 1250 to 975 m, or  $4' 32''$  to  $5' 49''$ . Basic elements of clothing and limbs were identified around 600 m ( $9' 27''$ ), while more detailed identification, such as hair color, appeared at 225 m (ca.  $25'$ ). Full identification of individualistic features only took place at about 60 m ( $1^\circ 34'$ ). These thresholds can be compared to Haidong Shang and Ian Bishop's by assuming an average elbow-to-elbow breadth of 50 cm for horizontal angles and calculating solid angles according to equation (3).<sup>144</sup> First detection, falling between 1.5 and  $2.2 \text{ min}^2$ , is lower than Shang and Bishop's minimum of  $5 \text{ min}^2$  with strong light-on-dark contrast. Human recognition, 6 to  $10 \text{ min}^2$ , falls within their range for detection under strong contrast. More detailed identification occurred at 27 and  $193 \text{ min}^2$ , respectively, which also compares favorably to Shang and Bishop's uninformed thresholds for identification ( $48\text{--}247 \text{ min}^2$ ). Full identification was achieved around  $2,700 \text{ min}^2$ , but this level of detail is likely unnecessary when considering the basic identification of an architectural building type.

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<sup>141</sup> Palmer 2019, 81–82; Pardo-García and Mérida-Rodríguez 2017; Chamberlain and Meitner 2013; Rodrigues et al. 2010; Grêt-Regamey et al. 2007; Shang and Bishop 2000.

<sup>142</sup> Shang and Bishop 2000.

<sup>143</sup> Fábrega-Álvarez and Parcero-Oubiña 2019.

<sup>144</sup> Panero and Zelink's (1979) 95% percentile average.



## Measuring the visual impact of Tibur's amphitheater

Another common set of thresholds is often employed in studies of potential visual impacts of planned infrastructure and mining.<sup>145</sup> These analyses are less focused upon basic detection. Instead, they seek to characterize an individual's perception of visual interruption in the landscape caused by these targets. As such, they define larger qualitative thresholds. Distinguishing between horizontal and vertical visual angles, they are based on an observer's field of view (FOV).<sup>146</sup> For horizontal angles, an object is considered insignificant if it occupies less than 2.5°, or 5%, of an individual's central horizontal field of binocular focus (about 50°). Above this threshold, it is classified as "potentially noticeable" until 30°, or 60%, of the central field of focus, after which it is considered "potentially visually dominant." For vertical angles, the values are much smaller as only the "natural" 10° line of sight is considered, resulting in thresholds at 0.5° (5%) and 2.5° (25%). Pastor Pardo-García and César Mérida-Rodríguez extrapolated visual magnitude thresholds using the corresponding horizontal and vertical angles: 1.25 deg<sup>2</sup> and 75 deg<sup>2</sup>.<sup>147</sup> Unlike Shang and Bishop's or IDV thresholds, based on empirical data, these values are strictly qualitative and useful for general assessment only. Moreover, there is no agreed standard human FOV for analysis, so the resultant percentages or ratios of perceived object areas vary widely in different studies.<sup>148</sup> Numerous other factors, such as visual exposure (i.e., the amount of occlusion caused by intervening features) and height ratio (i.e., the degree to which an object extends above the background horizon), also impact viewer perceptions.<sup>149</sup> Human response and sensitivity to such stimuli are also culturally and even individually determined.<sup>150</sup>

Despite their lack of uniformity, these thresholds provide a framework within which to interpret the potential visibility and visual impact of Tibur's amphitheater. Basic detection, but not identification, could occur at values as low as 2' or 1.5 min<sup>2</sup>, but building recognition would probably require around 5' or 6 to 10 min<sup>2</sup>. Amphitheater identification would likely coincide with 25' or as little as 14 to 27 min<sup>2</sup> under perfect conditions, while full identification should be expected above 1.5° or 2,700 min<sup>2</sup>. The point at which the amphitheater constituted a significant visual landmark, however, is far more subjective, and would likely have required much larger viewing angles, at a minimum, 0.5° vertically or 1.25 deg<sup>2</sup>.

### Results and discussion

The amphitheater's viewshed is overwhelmingly oriented to the west, with most visibility in other directions severely hindered by the tall ranges of the Monti Tiburtini, except for a narrow band near Tibur. Within this western expanse, steep ravines carved by small tributaries of the Aniene River periodically block views, while elevated volcanic ridges afford clear sightlines. Closer to Tibur, the Acque Albule basin, an ancient travertine

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<sup>145</sup> E.g., Graham-Higgs et al. 2009, B1–B7; Haack et al. 2013, Appendix A.

<sup>146</sup> Based on FOV standards as defined in Panero and Zelnick 1979.

<sup>147</sup> Pardo-García and Mérida-Rodríguez 2017, 60–61. 1.25 deg<sup>2</sup> erroneously cited as 12.5 deg<sup>2</sup> in Table 2.

<sup>148</sup> E.g., Rodrigues et al. (2010) indexed a ratio of visual magnitude to that of a half sphere, while Minelli et al. (2014) devised a dimensionless ratio of perceived object area to a "static" FOV area. FOV as in n. 145 above only considers a fraction of total human FOV.

<sup>149</sup> Palmer 2022, 3; Garrido-Velarde et al. 2018; Sullivan and Meyer 2014, 42–50.

<sup>150</sup> Sullivan 2020.

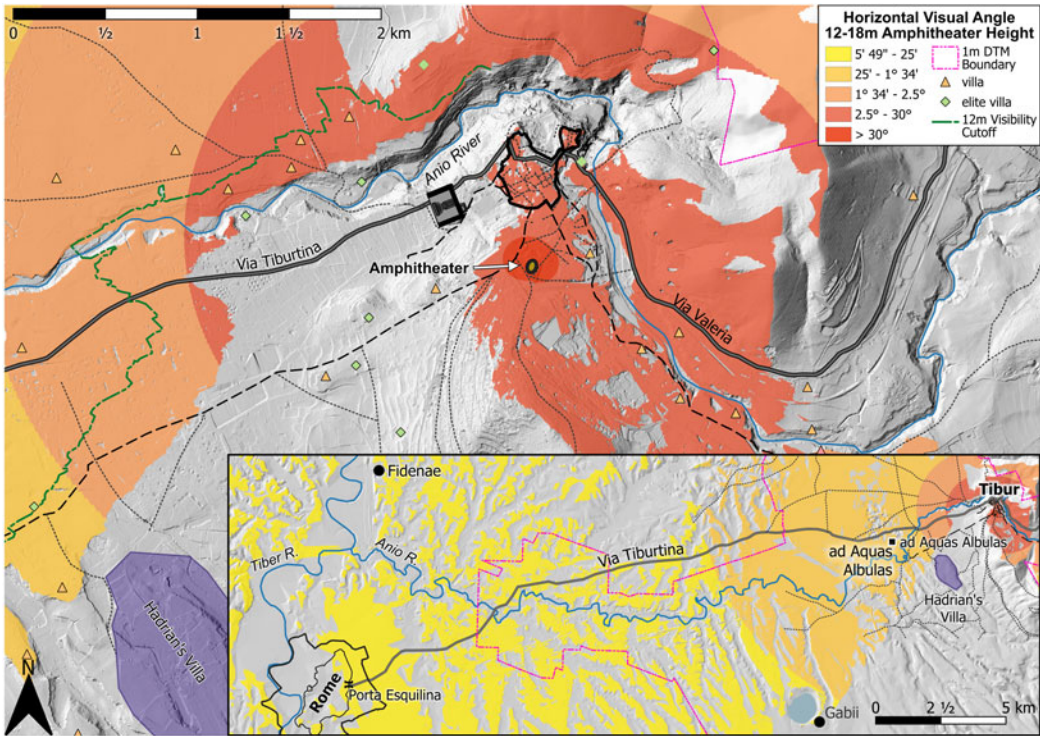


Fig. 8. Horizontal vertical angle. Dash-dotted line indicates the edge of visibility for a 12 m tall façade. (M. Notarian.)

quarry still in use, forms a series of depressions in an otherwise large alluvial plain with good visibility. The viewed is abruptly terminated 2 to 1.6 km from the city as the amphitheater recedes below the slopes of Monte Ripoli, on which it was located. In total, the amphitheater was observable along 61% of the 27 km of the Via Tiburtina between the Porta Esquilina in Rome and the Porta Maggiore in Tibur.

The calculated horizontal angles confirm that the amphitheater was technically visible from as far as Rome, subtending to 10.5' at the Esquiline Gate, 25.6 km away (Fig. 8).<sup>151</sup> This surpasses IDV's threshold for recognition, suggesting a viewer, in ideal conditions, could not just detect an object in the distance, but already recognize the structural type of an amphitheater. Moving east from Rome, at 11 km away the subtended angle surpasses 25', enabling more detailed recognition in which individual features of its façade, such as columns or arcades, may have been visible. Just under 3 km from the amphitheater, the horizontal angle surpassed the threshold for full identification (1° 34') where all its structural details were discernible. However, these measures do not yet meet the qualitative levels for significance. It is at this point the effects of Tibur's elevation have a negative impact. At 12 m tall, the façade would have disappeared below the horizon at a distance of around 2 km, just before the 2.5° threshold for potential noticeability was surpassed. An 18 m-tall façade would have been visible until 1.8 to 1.6 km away, barely reaching 2.5°. Therefore, the amphitheater only achieved potential visual significance in the final

<sup>151</sup> Amphitheater height has no impact on horizontal angles, except closer to Tibur, where the hillside obscures its façade.

## Measuring the visual impact of Tibur's amphitheater

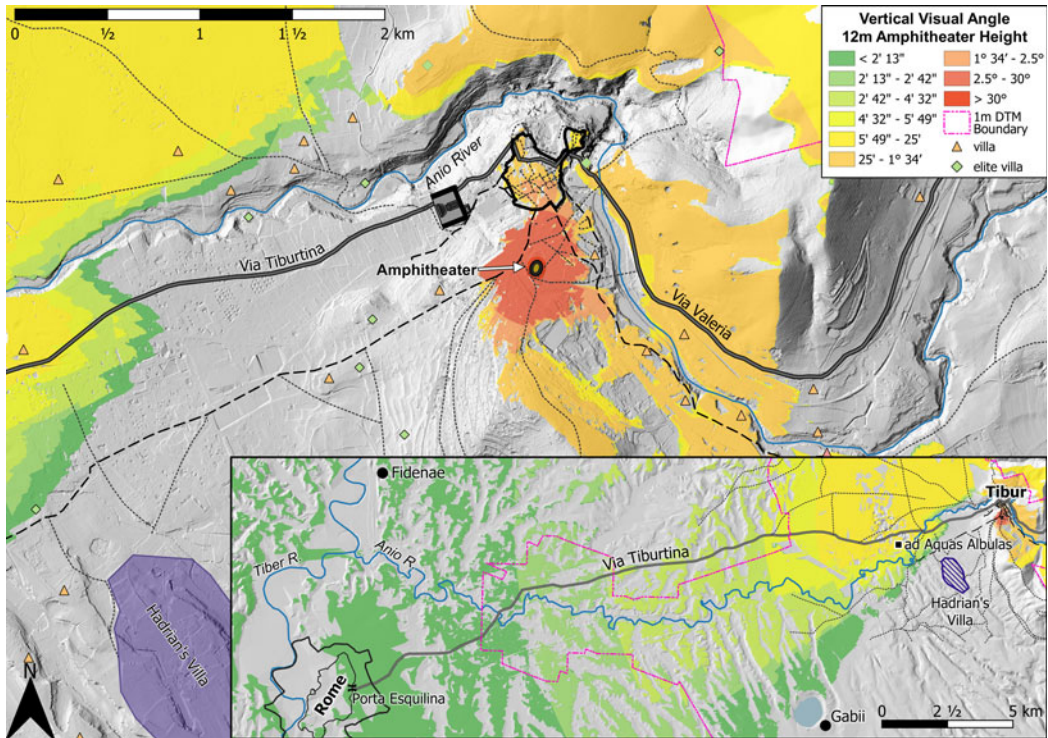


Fig. 9. Vertical visual angle – 12 m façade. (M. Notarian.)

approaches along the Via Tiburtina, just as it disappeared altogether in the final kilometer and a half.

In the vertical direction, the amphitheater presents a much shorter length and is more susceptible to landform obstruction, with greater variance between the minimum and maximum height estimates (Figs. 9, 10). Yet, vertical angles are in general more sensitive to visual significance because of tall structures' propensity to rise above the horizon.<sup>152</sup> From the Esquiline Gate, only an 18 m-tall façade meets the criteria for basic detection, not recognition, at 2' 25". A 12 m-tall amphitheater would be beyond detection (1' 36") and would only become detectable from about 18.6 km away. A traveler moving east on the Via Tiburtina would gradually be able to identify the building at 13 km and 9 km away, respectively, at the maximum and minimum height estimates, but would not reach full identification before it disappeared below the horizon near Tibur. In the final approach, it would even become unidentifiable again as more of its façade receded below the hill.

The difference in quality between horizontal and vertical angles makes interpretation of the amphitheater's visibility challenging. Accordingly, visual magnitude offers a superior measure as it incorporates both horizontal and vertical dimensions. It can also differentiate, using Shang and Bishop's thresholds, the distances at which more than half of travelers might have identified it, factoring in their expectation of seeing an amphitheater ornamenting Tibur's suburbs as well as varying environmental factors. At the Esquiline Gate, the maximum and minimum spread is 25.5 to 17 min<sup>2</sup>, respectively (Figs. 11, 12). This suggests

<sup>152</sup> Ogburn 2006, 407.

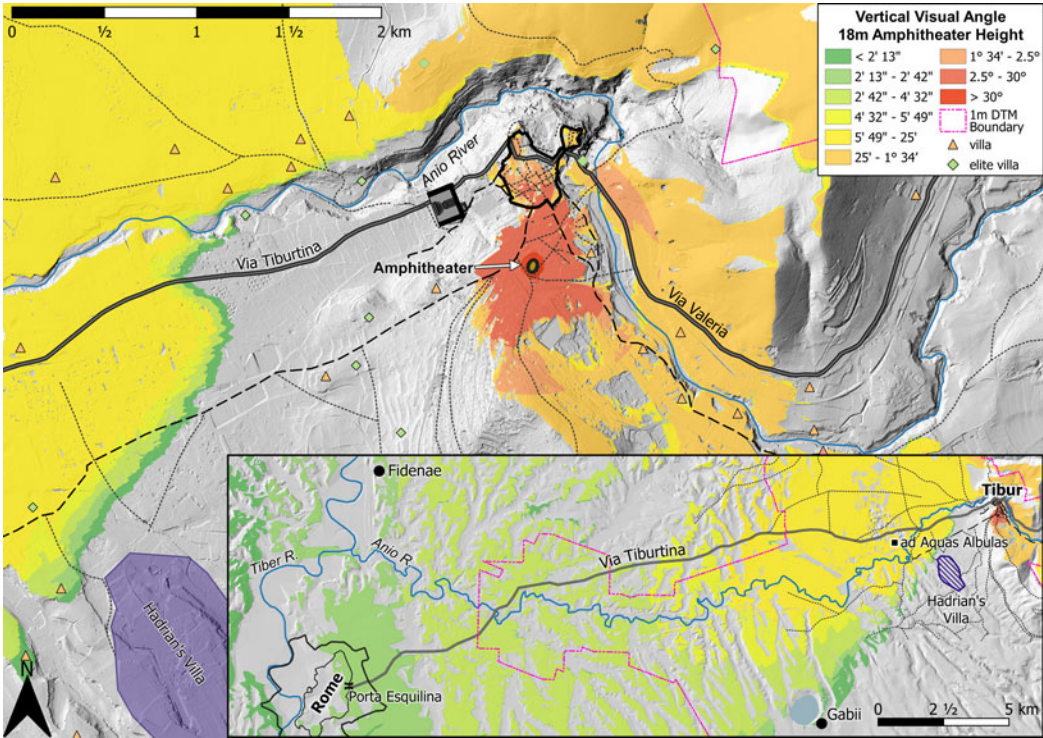


Fig. 10. Vertical visual angle – 18 m façade. (M. Notarian.)

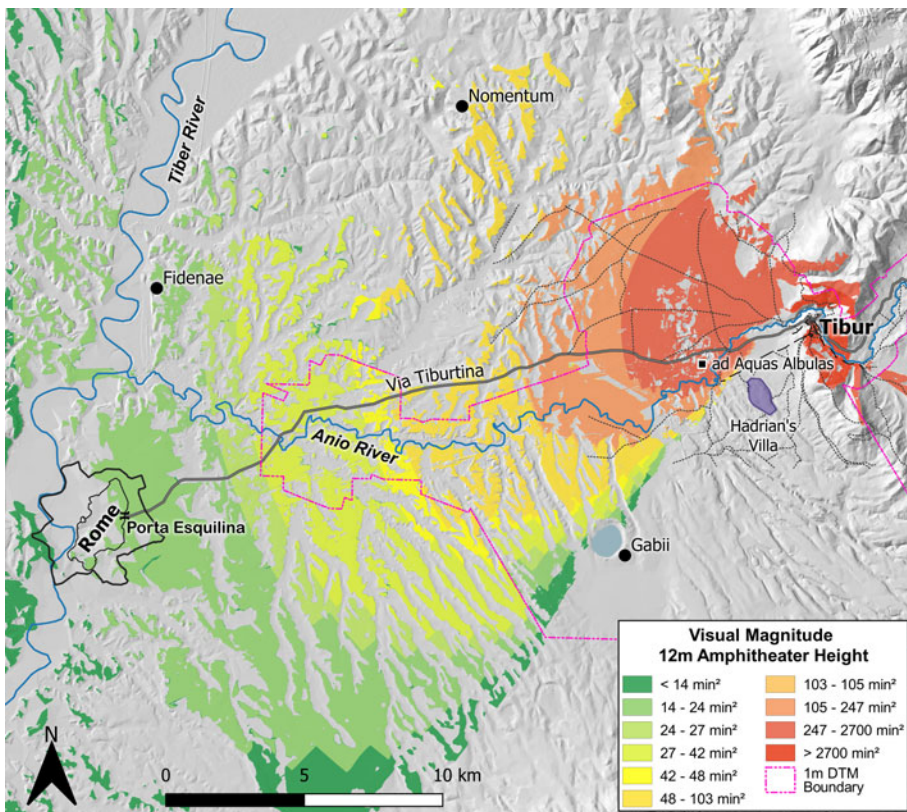


Fig. 11. Visual magnitude: detection and identification scale – 12 m façade. (M. Notarian.)

## Measuring the visual impact of Tibur's amphitheater

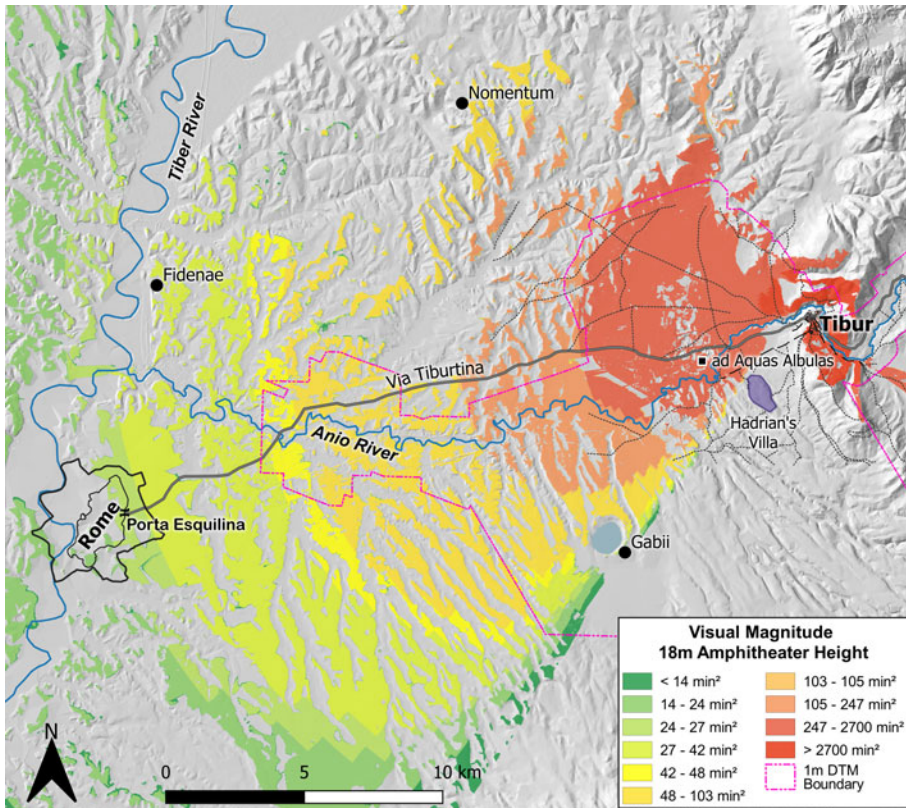


Fig. 12. *Visual magnitude: detection and identification scale – 18 m façade.* (M. Notarian.)

an 18 m-tall amphitheater would have been minimally identifiable to those consciously looking for it only under ideal conditions, such as strong contrast and a clear atmosphere, while a 12 m amphitheater would have been merely recognizable. From about 18.8 to 15.4 km (48 min<sup>2</sup>), the amphitheater would have become detectable even under adverse low contrast conditions, while viewers unfamiliar with the amphitheater's presence may have identified it under high contrast. From 12.7 to 10.3 km (105 min<sup>2</sup>), it would become identifiable to observers looking for it under low contrast situations, while between 8.3 and 6.8 km (247 min<sup>2</sup>) even the uninformed observer could have identified it in these same poor conditions. On the qualitative scale, however, neither the maximum nor the minimum height estimate would have achieved potential noticeability (1.25 deg<sup>2</sup>) on any stretch of the Via Tiburtina before entering the city itself, leaving in doubt the amphitheater's hypothetical impact on the city's self-presentation to suburban audiences (Figs. 13, 14). Moreover, the amphitheater was not visible at all from Hadrian's Villa, nor from many of the elite villas occupying Monte Ripoli's slopes. Nonetheless, its north-to-south orientation did stretch its visibility much further towards the west than had the builders aligned it east to west.

While the route along the Via Tiburtina from Rome may not have commanded attention, the amphitheater's presence would certainly have had a visual impact on travelers approaching along the Via Valeria from the east, or those using more southerly alternate routes from the west. Its apparent size crossed the 2.5° threshold for potential noticeability almost 1.5 km to the southeast on the Via Valeria, and it would have remained in

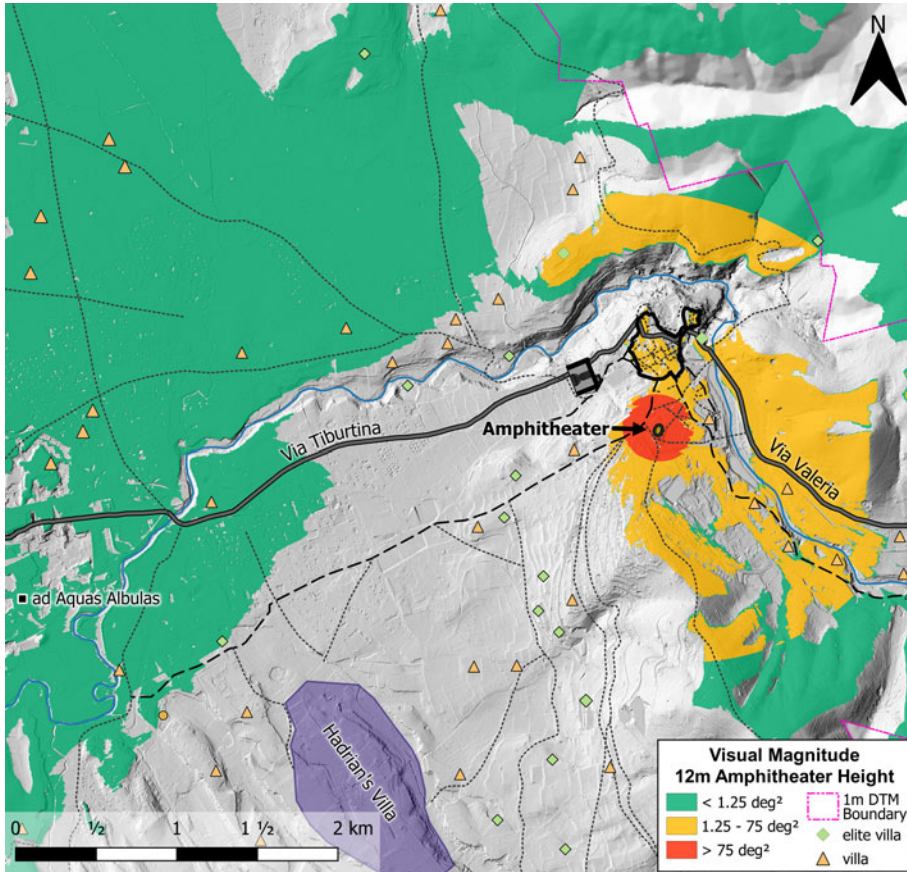


Fig. 13. Visual magnitude: qualitative scale – 12 m façade. (M. Notarian.)

view, possible obstruction by other structures notwithstanding, the entire way to the civic center. Travelers heading for Rome may also have chosen to bypass the city using a bridge across the Anio River to the south. Here they would have confronted the amphitheater's widest axis, passing just to its south through the zone of potential visual dominance ( $> 75 \text{ deg}^2$ ). Interestingly, from the opposite direction, this alternate route would have presented the amphitheater as a conspicuous monumental surprise as one approached the city's southern suburbs. Travelers coming from Hadrian's Villa or other elite villas dotted along Monti Ripoli's western slopes would not have seen the amphitheater at all before climbing the hill. Once there, however, no observer would have failed to notice its visually dominant façade as they either turned north to enter the city, passing the amphitheater's western major axis, or continued to its south to bypass Tibur and merge with the Via Valeria across the river. This ensured both major routes to the city from Rome were monumentalized. Along the Via Tiburtina, as the amphitheater disappeared below the hillside, the viewer's focus turned to the sanctuary of Hercules Victor with its *via tecta*, which had long defined the city's monumental entrance. Those approaching along the southern route, however, perhaps purposefully avoiding the covered passageway underneath the temple, or using the most direct route from the luxury villas adjacent to the imperial estate, would now be presented with the second-largest urban structure in the city – its amphitheater.

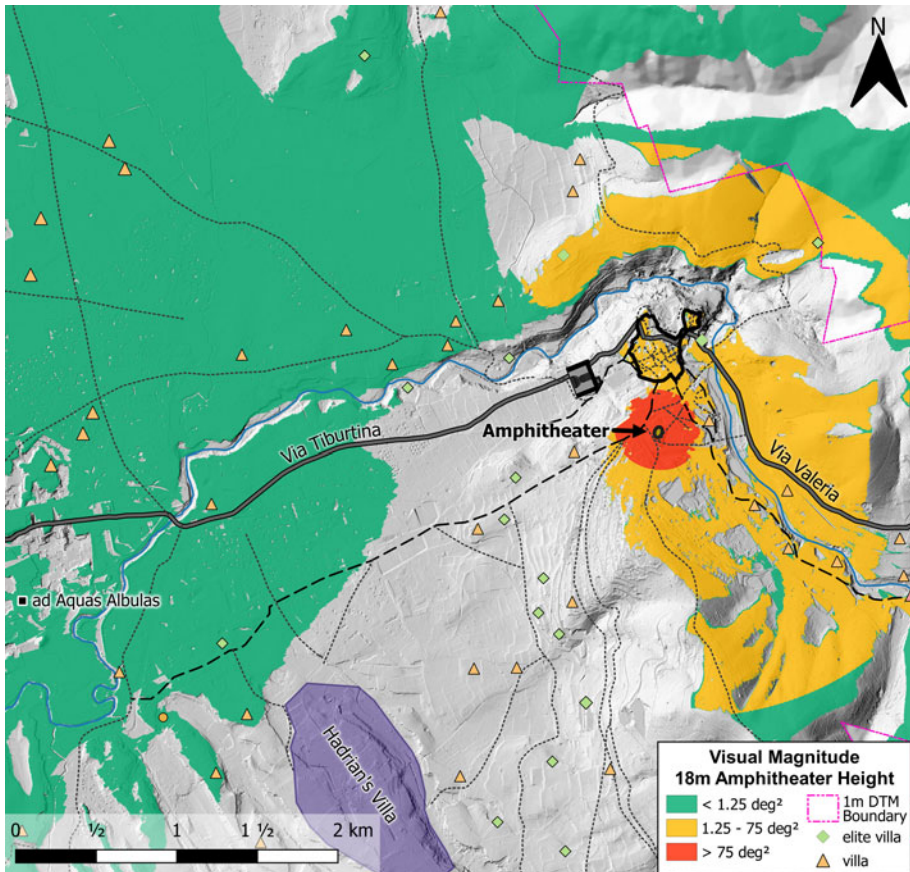


Fig. 14. Visual magnitude: qualitative scale – 18 m façade. (M. Notarian.)

## Conclusion

The rationale behind permanent amphitheater construction in Roman Italy was multifaceted and complex. While benefactors may have anticipated certain communal economic benefits, considerations of urban status and their role in negotiating social hierarchies must also have loomed large. As argued, a close examination of local context, including its topographic, socio-political, and visual dimensions, offers one method to untangle these varying factors. As the largest municipal building project in two centuries, concurrent with the massive new imperial estate in its territory, Tibur's amphitheater must be examined within the dynamics of the city's mutable and liminal civic status, simultaneously peripheral and autonomous, yet also thoroughly absorbed into the capital's orbit.

The suburban location of Tibur's amphitheater was not unexpected in an old and densely developed settlement. Yet, it also functioned to integrate the city's expanded suburban district into its older urban core through processions and more informal movement along its extramural road network. Furthermore, it must be stressed that, although hindered by complex terrain with river gorges and steep gradients, municipal authorities chose a previously developed location from which the structure would be visible for a considerable distance, rather than a downhill locale on flatter land. Its architects counterintuitively oriented its major axis into the rising hillside to the south, exposing its widest flank to the vast vista to the west along the Via Tiburtina, while also facing its continuation, the Via Valeria, to the east.

Thus, purposefully or merely fortuitously, the city's urban status was reinforced for external audiences – including the emperor and the imperial elite in the region's villas, and the thousands of inhabitants in Rome and the suburbium. As a potent symbol of Roman urban culture, the amphitheater clearly delineated the civic center from the crowded mass of villas and suburban structures that covered Rome's environs. It ensured all routes into the city or around it from the direction of the capital offered monumental architecture to the traveler, especially the alternate route to the civic center that may have gained especial importance with the construction of Hadrian's Villa. Rather than relying on impressionistic description, viewshed analysis, incorporating techniques developed in landscape management and visual impact assessment, provides quantifiable measures of not just potential visibility, but also the visual dominance of monumental architecture in the ancient landscape. Similar methods could be applied to the dozens of other Roman amphitheaters for which visual prominence has been suggested, or 3D visualizations could further refine our understanding of the interplay between the various factors that affected visibility, such as atmosphere, light, color, seasonality, and interference from vegetation and other structures.<sup>153</sup>

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## References

- Baldwin, B. 1988. "Four problems with Florus." *Latomus* 47: 134–42.
- Benefiel, R. 2016. "Regional interaction." In *A Companion to Roman Italy*, ed. A. E. Cooley, 441–58. Chichester: John Wiley & Sons.
- Bishop, I. 2019. "The implications for visual simulation and analysis of temporal variation in the visibility of wind turbines." *Landscape and Urban Planning* 184: 59–68. <https://doi.org/10.1016/j.landurbplan.2018.12.004>.
- Boatwright, M. 2000. *Hadrian and the Cities of the Roman Empire*. Princeton: Princeton University Press.
- Bodei Giglioni, G. 1977. "Pecunia fanatica: l'incidenza economica dei templi laziali." *RivStorIt* 89: 33–76.
- Bomgardner, D. 2021. *The Story of the Roman Amphitheatre*, 2nd ed. London: Routledge.
- Bonetto, J. 2003. "Gli edifici per spettacolo e la viabilità nelle città dell'Italia romana." In *Gli edifici per spettacoli nell'Italia romana*, ed. G. Tosi, 923–37. Rome: Quasar.
- Bourne, E. 1916. *A Study of Tibur, Historical, Literary and Epigraphical, from the Earliest Times to the Close of the Roman Empire*. Johns Hopkins University PhD Dissertations 62. Menasha: George Banta.
- Bowes, K., S. Collins-Elliott, and C. Grey. 2020. "Where did Roman peasants live? Habitation and distributed habitation." In *The Roman Peasant Project: 2009–2014. Excavating the Roman Rural Poor*, ed. K. Bowes, 435–69. Philadelphia: University of Pennsylvania Museum of Archaeology and Anthropology.
- Bowes, K., and A. Hoti. 2003. "An amphitheatre and its afterlives: Survey and excavation in the Durrës amphitheatre." *JRA* 16: 380–94.
- Buill, F., M. A. Núñez-Andrés, J. M. Puche, and J. M. Macias. 2015. "Geometric analysis of the original stands of Roman amphitheater in Tarragona: Method and results." *Journal of Cultural Heritage* 16: 640–47.
- Carter, M. J., and J. Edmondson. 2015. "Spectacle in Rome, Italy, and the provinces." In *The Oxford Handbook of Roman Epigraphy*, ed. C. Bruun and J. Edmondson, 537–58. Oxford: Oxford University Press.

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<sup>153</sup> Sullivan 2020; Bishop 2019; Wróżyński et al. 2016.



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- Cassibry, K. 2018. "Spectacular translucence: The games in glass." *Theoretical Roman Archaeology Journal* 1.1: article 5. <https://doi.org/10.16995/traj.359>.
- Chamberlain, B., and M. Meitner. 2013. "A route-based visibility analysis for landscape management." *Landscape and Urban Planning* 111: 13–24.
- Chamberland, G. 2007. "A gladiatorial show produced in *sordidam mercedem* (Tacitus *Ann.* 4.62)." *Phoenix* 61.1–2: 136–49.
- Champlin, E. 1982. "The *suburbium* of Rome." *AJAH* 7, no. 2: 97–117.
- Coarelli, F. 1987. *I santuari del Lazio in età repubblicana*. Rome: La Nuova Italia Scientifica.
- Codina-Peñarroja, C. 2020. "Reconstrucción virtual del anfiteatro de Tarragona a través de la procesión inaugural." *Virtual Archaeology Review* 11, no. 23: 127–40. <https://doi.org/10.4995/var.2020.12806>.
- Cooley, A., and M. G. L. Cooley. 2014. *Pompeii and Herculaneum: A Sourcebook*, 2nd ed. London: Routledge.
- del Vecchio, F. 2001. "Vasi di vetro con rilievi di ludi circensi e gladiatorii." In *Vetri di ogni tempo: scoperte, produzione, commercio, iconografia: atti della V Giornata nazionale di studio, Massa Martana (Perugia), 30 ottobre 1999*, ed. D. Ferrari, 23–28. Milan: Comune di Milano, Civiche Raccolte Archeologiche.
- DeMarrais, E., L. J. Castillo, and T. Earle. 1996. "Ideology, materialization, and power strategies." *CurrAnthr* 37: 15–31.
- Dey, H. 2011. *The Aurelian Wall and the Refashioning of Imperial Rome, A.D. 271–855*. Cambridge: Cambridge University Press.
- Eck, W. 1984. "Senatorial self-representation: Developments in the Augustan period." In *Caesar Augustus: Seven Aspects*, ed. F. Millar and E. Segal, 129–67. Oxford: Clarendon.
- Eck, W. 1996. "Onori per persone di alto rango sociopolitico in ambito pubblico e privato." In *Tra epigrafia, prosopografia e archeologia: scritti scelti, rielaborati ed aggiornati*, 299–318. Rome: Quasar.
- Emmerson, A. 2020. *Life and Death in the Roman Suburb*. Oxford: Oxford University Press.
- Evans, H. B. 1993. "In *Tiburium usum*: Special arrangements in the Roman water system (Frontinus, *Aq.* 6.5)." *AJA* 97: 447–55.
- Fábrega-Álvarez, P., and C. Parceró-Oubiña. 2019. "Now you see me. An assessment of the visual recognition and control of individuals in archaeological landscapes." *JAS* 104: 56–74. <https://doi.org/10.1016/j.jas.2019.02.002>.
- Facenna, D. 1948. "Tivoli. Prima notizia intorno al rinvenimento dell'anfiteatro romano." *NSc* 1948: 278–83.
- Fagan, G. 2014. "Gladiatorial combat as alluring spectacle." In *A Companion to Sport and Spectacle in Greek and Roman Antiquity*, ed. P. Christesen and D. Kyle, 465–77. Chichester: Wiley Blackwell.
- Favro, D. 2006. "The iconiCITY of ancient Rome." *Urban History* 33: 20–38.
- Fisher, P. F. 1994. "Probable and fuzzy models of the viewshed operation." In *Innovations in GIS: Selected Papers from the First National Conference on GIS Research UK*, ed. M. F. Worboys, 161–75. London: Taylor and Francis.
- Fontana, G. 2022. "Italy's hidden hillforts: A large-scale lidar-based mapping of Samnium." *JFA* 47: 245–61. <https://doi.org/10.1080/00934690.2022.2031465>.
- Frayn, J. M. 1993. *Markets and Fairs in Roman Italy: Their Social and Economic Importance from the Second Century BC to the Third Century AD*. Oxford: Clarendon Press.
- Frontoni, R. 1997. "Anfiteatro di Tivoli (relazione preliminare)." *Atti e Memorie della Società Tiburtina di Storia ed d'Arte* 70: 121–36.
- Fulminante, F. 2014. *The Urbanisation of Rome and Latium Vetus: From the Bronze Age to the Archaic Era*. New York: Cambridge University Press.
- Futrell, A. 1997. *Blood in the Arena: The Spectacle of Roman Power*. Austin: University of Texas Press.
- García Sánchez, J. 2018. "Archaeological LiDAR in Italy: Enhancing research with publicly accessible data." *Antiquity* 92, no. 364: 1–12. <https://doi.org/10.15184/aqy.2018.147>.
- Garrido-Velarde, J., M. J. Montero-Parejo, J. Hernández-Blanco, and L. García-Moruno. 2018. "Visual analysis of the height ratio between building and background vegetation. Two rural cases of study: Spain and Sweden." *Sustainability* 10, no. 8: 2593. <https://doi.org/10.3390/su10082593>.
- Giletti, F. 2018. "L'organizzazione del culto nell'Italia romana: il caso del santuario di Ercole a Tivoli." In *Il ruolo del culto nelle comunità dell'Italia antica tra IV e I sec. a.C.*, ed. E. Lippolis and R. Sassu, 395–422. Rome: Quasar.

- Gillings, M. 2012. "Landscape phenomenology, GIS and the role of affordance." *Journal of Archaeological Method and Theory* 19: 601–11.
- Gillings, M., and D. Wheatley. 2020. "GIS-based visibility analysis." In *Archaeological Spatial Analysis*, ed. M. Gillings, P. Hacigüzeller, and G. Lock, 313–32. London: Routledge.
- Giuliani, G. F. 1970. *Tibur: pars prima. Forma Italiae Regio I*, v.7. Rome: De Luca.
- Giuliani, G. F. 2004. *Tivoli: il santuario di Ercole vincitore*. Tivoli: Tiburis artistica.
- Golvin, J.-C. 1988. *L'Amphithéâtre romain: essai sur la théorisation de sa forme et de ses fonctions*. Paris: Diffusion de Boccard.
- Goodman, P. 2007. *The Roman City and Its Periphery: From Rome to Gaul*. New York: Routledge.
- Goodman, P. 2016. "Urban peripheries." In *A Companion to Roman Italy*, ed. A. Cooley, 308–29. West Sussex: John Wiley and Sons.
- Goodman, P. 2018. "Defining the city: The boundaries of Rome." In *A Companion to the City of Rome*, ed. C. Holleran and A. Claridge, 71–92. Hoboken: Wiley Blackwell.
- Graham-Higgs, N., T. Browne, and B. Marshall. 2009. *Yass Valley Wind Farm – Environmental Assessment*. Bega, NSW: NGH Environmental. <https://arkenergy.com.au/wind/yass-valley/downloads/>.
- Grêt-Regamey, A., I. D. Bishop, and P. Bebi. 2007. "Predicting the scenic beauty value of mapped landscape changes in a mountainous region through the use of GIS." *Environment and Planning B: Planning and Design* 34, no. 1: 50–67. <https://doi.org/10.1068/b32051>.
- Haack, P., A. Towers, A. Poon, and N. Jeffrey. 2013. *Mt Arthur Coal Open Cut Modification: Landscape and Visual Impact Assessment*. Melbourne: Urbis Pty Ltd.
- Hanson, J. W. 2016. *An Urban Geography of the Roman World, 100 BC to AD 300*. Oxford: Archaeopress.
- Hanson, J. W., and S. G. Ortman. 2017. "A systematic method for estimating the populations of Greek and Roman settlements." *JRA* 30: 301–24.
- Hanson, J. W., and S. G. Ortman. 2020. "Reassessing the capacities of entertainment structures in the Roman Empire." *AJA* 124: 417–40. <https://doi.org/10.3764/aja.124.3.0417>.
- Higuchi, T. 1983. *Visual and Spatial Structure of Landscapes*. Cambridge: MIT Press.
- Heyworth, S. J. 2007. *Cynthia: A Companion to the Text of Propertius*. Oxford: Oxford University Press.
- Hopkins, K. 1983. *Death and Renewal*. Cambridge: Cambridge University Press.
- Iverson, W. D. 1985. "And that's about the size of it: Visual magnitude as a measurement of the physical landscape." *Landscape Journal* 4: 14–22. <https://doi.org/10.3368/lj.4.1.14>.
- Jaczynowska, M. 1981. "Le culte de l'Hercule romain au temps du Haut-Empire." *ANRW II.17.2*: 631–61.
- Jouffroy, H. 1986. *La construction publique en Italie et dans l'Afrique romaine*. Strasbourg: AECR.
- Junkelman, M. 2000. "Familia Gladiatoria: The heroes of the amphitheatre." In *Gladiators and Caesars: The Power of Spectacle in Ancient Rome*, ed. E. Kohne and C. Ewigleben, 31–74. Berkeley: University of California Press.
- Kleijwegt, M. 1994. "'Iuvenes' and Roman Imperial society." *Acta Classica* 37: 79–102.
- Künzl, E., and G. Koepfel. 2002. *Souvenirs und Devotionalien: Zeugnisse des geschäftlichen, religiösen und kulturellen Tourismus im antiken Römerreich*. Mainz: von Zabern.
- Laes, C., and J. Strubbe. 2014. *Youth in the Roman Empire: The Young and the Restless Years?* Cambridge: Cambridge University Press.
- Laurence, R., A. S. Esmonde Cleary, and G. Sears. 2011. *The City in the Roman West c.250 BC – AD 250*. Cambridge: Cambridge University Press.
- Lavan, L. 2012. "From polis to emporion? Retail and regulation in the Late Antique city." In *Trade and Markets in Byzantium*, ed. by C. Morrisson, 333–78. Washington: Dumbarton Oaks Research Library and Collection.
- de Ligt, L. 1993. *Fairs and Markets in the Roman Empire: Economic and Social Aspects of Periodic Trade in a Pre-industrial Society*. Amsterdam: Gieben.
- Llobera, M. 2007. "Reconstructing visual landscapes." *WorldArch* 39: 51–69.
- Lomas, K. 1997. "'The idea of a city: Elite ideology and the evolution of urban form in Italy, 200 BC–AD 200.'" In *Roman Urbanism: Beyond the Consumer City*, ed. H. Parkins, 21–41. London: Routledge.
- Lomas, K. 2003. "Public building, urban renewal and euergetism in Early Imperial Italy." In *Bread and Circuses: Euergetism and Municipal Patronage in Roman Italy*, ed. K. Lomas and T. Cornell, 28–45. London: Routledge.

## Measuring the visual impact of Tibur's amphitheater

- Mandich, M. 2019. "Ancient city, universal growth? Exploring urban expansion and economic development on Rome's eastern periphery." *Frontiers in Digital Humanities* 6: 18. <https://doi.org/10.3389/fdigh.2019.00018>.
- Mari, Z. 1991a. "Scoperte archeologiche nei comuni di Tivoli e Guidonia-Montecelio." *Atti e Memorie della Società Tiburtina di Storia ed Arte* 64: 121–38.
- Mari, Z. 1991b. *Tibur: pars quarta*. Forma Italiae 35. Florence: L. S. Olschki.
- Mari, Z. 1994. "Scoperte archeologiche nel territorio tiburtino e nella Valle dell'Aniene (IV)." *Atti e Memorie della Società Tiburtina di Storia ed Arte* 67: 145–80.
- Mari, Z. 2001. "Scoperte archeologiche nel territorio tiburtino e nella Valle dell'Aniene (VI)." *Atti e Memorie della Società Tiburtina di Storia ed Arte* 74: 41–88.
- Mari, Z. 2002. "Tivoli in età adrianea." In *Villa Adriana: paesaggio antico e ambiente moderno: elementi di novità e ricerche in corso: atti del Convegno, Roma, Palazzo Massimo alle Terme, 23–24 giugno 2000*, ed. A. M. Reggiani, 181–202. Milan: Electa.
- Mari, Z., and F. Boanelli. 1991. "La villa di Quintilio Varo." *Boll-Arch* 10: 37–50.
- Mari, Z., and E. Moschetti. 1993. "Scoperte archeologiche nel territorio tiburtino (III)." *Atti e Memorie della Società Tiburtina di Storia ed Arte* 66: 109–46.
- Marzano, A. 2007. *Roman Villas in Central Italy: A Social and Economic History*. Leiden: Brill.
- Minelli, A., I. Marchesini, F. E. Taylor, P. De Rosa, L. Casagrande, and M. Cenci. 2014. "An open source GIS tool to quantify the visual impact of wind turbines and photovoltaic panels." *Environmental Impact Assessment Review* 49: 70–78.
- Morley, N. 1996. *Metropolis and Hinterland: The City of Rome and the Italian Economy, 200 B.C.–A.D. 200*. Cambridge: Cambridge University Press.
- Nardelli, M. 2003. "'Natura loci' e 'aedificatio': il rapporto fra terreno e strutture negli edifici per spettacoli romani in Italia." In *Gli edifici per spettacoli nell'Italia romana*, ed. G. Tosi, 941–60. Rome: Quasar.
- Nicols, J. 2013. Supplementary data for the monograph *Civic Patronage in the Roman Empire*. University of Oregon. <https://doi.org/10.7264/N3PC308P>.
- Ogburn, D. E. 2006. "Assessing the level of visibility of cultural objects in past landscapes." *JAS* 33, no. 3: 405–13.
- Palmer, J. F. 2019. "The contribution of a GIS-based landscape assessment model to a scientifically rigorous approach to visual impact assessment." *Landscape and Urban Planning* 189: 80–90.
- Palmer, J. F. 2022. "Deconstructing viewshed analysis makes it possible to construct a useful visual impact map for wind projects." *Landscape and Urban Planning* 225: 1–13.
- Panero, J., and M. Zelnik. 1979. *Human Dimension and Interior Space*. New York: Whitney Library of Design.
- Pardo-García, S., and M. Mérida-Rodríguez. 2017. "Measurement of visual parameters of landscape using projections of photographs in GIS." *Computers, Environment and Urban Systems* 61: 56–65.
- Parsaee, M., C. M. H. Demers, A. Potvin, M. Hébert, and J.-F. Lalonde. 2021. "Window view access in architecture: Spatial visualization and probability evaluations based on human vision fields and biophilia." *Buildings* 11, no. 12: 627. <https://doi.org/10.3390/buildings11120627>.
- Patterson, J. R. 2000. "On the margins of the city of Rome." In *Death and Disease in the Ancient City*, ed. V. M. Hope and E. Marshall, 85–103. London: Routledge.
- Patterson, J. R. 2006. *Landscapes and Cities: Rural Settlement and Civic Transformation in Early Imperial Italy*. Oxford: Oxford University Press.
- Pintucci, A. 2006. "I materiali del teatro del santuario di Ercole Vincitore a Tivoli." In *Lazio e Sabina* 3, ed. G. Ghini, 33–36. Rome: De Luca.
- Pintucci, A. 2007. "La ricostruzione della decorazione architettonica del teatro del Santuario di Ercole Vincitore a Tivoli." In *Lazio e Sabina* 4, ed. G. Ghini, 47–50. Rome: De Luca.
- Popkin, M. 2018. "Urban images in glass from the Late Roman Empire: The souvenir flasks of Puteoli and Baiae." *AJA* 122: 427–62.
- Quilici, L. 1974. "La campagna romana come suburbio di Roma antica." *PP* 29: 410–38.
- Robinson, O. F. 1992. *Ancient Rome: City Planning and Administration*. London: Routledge.
- Rodrigues, M., R. Montañes, and N. Fueyo. 2010. "A method for the assessment of the visual impact caused by the large-scale deployment of renewable-energy facilities." *Environmental Impact Assessment Review* 30: 240–46.

- Roueché, C. 2004. *Aphrodisias in Late Antiquity: The Late Roman and Byzantine Inscriptions*, 2nd ed. <http://insaph.kcl.ac.uk/ala2004>.
- Shang, H., and I. D. Bishop. 2000. "Visual thresholds for detection, recognition and visual impact in landscape settings." *Journal of Environmental Psychology* 20: 125–40.
- Sullivan, E. 2020. *Constructing the Sacred: Visibility and Ritual Landscape at the Egyptian Necropolis of Saqqara*. Stanford: Stanford University Press. <https://doi.org/10.21627/2020cts>.
- Sullivan, R., and M. Meyer. 2014. *Guide to Evaluating Visual Impact Assessments for Renewable Energy Projects*. Natural Resource Report NPS/ARD/NRR – 2014/836. Fort Collins, CO: U.S. Department of the Interior, National Park Service, Natural Resource Stewardship and Science.
- Syme, R. 1982–1983. "Spaniards at Tivoli." *Ancient Society* 13–14: 241–63.
- Tanzilli, S. 2004. "L'anfiteatro romano di Cassino." In *Lazio e Sabina* 2, ed. G. Ghini, 97–102. Rome: De Luca.
- Tarquini, S., I. Isola, M. Favalli, F. Mazzarini, M. Bisson, M. T. Pareschi, and E. Boschi. 2007. "TINITALY/01: A new Triangular Irregular Network of Italy." *Annals of Geophysics* 50, no. 3: 407–25.
- Taylor, L. R. 1924. "Seviri Equitum Romanorum and municipal Seviri: A study in pre-military training among the Romans." *JRS* 14: 158–71.
- Tombrägel, M. 2012. *Die republikanischen Otiumvillen von Tivoli*. Wiesbaden: Ludwig Reichert Verlag.
- Torelli, M. 1995. "Innovations in Roman construction techniques between the first century B.C. and the first century A.D." In *Studies in the Romanization of Italy*, ed. and transl. H. Fracchia and M. Gualtieri, 213–45. Edmonton: University of Alberta Press.
- Tosi, G., ed. 2003. *Gli edifici per spettacoli nell'Italia romana*. Rome: Quasar.
- Tuck, S. 2008/2009. "Scheduling spectacle: Factors contributing to the dates of Pompeian 'munera'." *CJ* 104: 123–43.
- Van der Graaff, I. 2019. *The Fortifications of Pompeii and Ancient Italy*. London: Routledge.
- Várhelyi, Z. 2010. *The Religion of Senators in the Roman Empire: Power and the Beyond*. Cambridge: Cambridge University Press.
- Verhagen, P. 2018. "Spatial analysis in archaeology: Moving into new territories." In *Digital Geoarchaeology: New Techniques for Interdisciplinary Human-Environmental Research*, ed. C. Siart, M. Forbriger, and O. Bubbenzer, 11–25. Cham: Springer International.
- Wernke, S. A., L. E. Kohut, and A. Traslaviña. 2017. "A GIS of affordances: Movement and visibility at a planned colonial town in highland Peru." *JAS* 84: 22–39.
- West, D. 2002. *Horace Odes III: Dulce Periculum*. Oxford: Oxford University Press.
- Wheatley, D., and M. Gillings. 2000. "Vision, perception and GIS: Developing enriched approaches to the study of archaeological visibility." In *Beyond the Map: Archaeology and Spatial Technologies*, ed. G. Lock, 1–27. Amsterdam: IOS Press.
- Wilson-Jones, M. 1993. "Designing amphitheatres." *RM* 100: 391–441.
- Witcher, R. 2005. "The extended metropolis: *Urbs, suburbium* and population." *JRA* 18: 120–38.
- Witcher, R. 2006. "Settlement and society in Early Imperial Etruria." *JRS* 96: 88–123.
- Witcher, R. 2008. "Regional field survey and the demography of Roman Italy." In *People, Land, and Politics: Demographic Developments and the Transformation of Roman Italy, 300 BC–AD 14*, ed. L. de Ligt and S. Northwood, 273–303. Leiden: Brill.
- Witcher, R. 2013. "(Sub)urban surroundings." In *The Cambridge Companion to Ancient Rome*, ed. P. Erdkamp, 205–25. Cambridge: Cambridge University Press.
- Witcher, R. 2020. "The early and mid-imperial landscapes of the middle Tiber valley (c. 50 BC–AD 250)." In *The Changing Landscapes of Rome's Northern Hinterland: The British School at Rome's Tiber Valley Project*, ed. H. Patterson, R. Witcher, and H. Di Giuseppe, 117–207. Summertown: Archaeopress.
- Wolfram Thill, E. 2010. "Civilization under construction: Depictions of architecture on the column of Trajan." *AJA* 114: 27–43.
- Wróżyński, R., M. Sojka, and K. Pyszny. 2016. "The application of GIS and 3D graphic software to visual impact assessment of wind turbines." *Renewable Energy* 96: 625–35. <https://doi.org/10.1016/j.renene.2016.05.016>.
- Zanker, P. 2000. "The city as symbol: Rome and the creation of an urban image." In *Romanization and the City: Creation, Transformations, and Failures*, ed. E. Fentress, 25–41. Portsmouth: JRA.