

**The Urban-Suburban  
Spatial Structure of Han and Tang Chang'an:  
Historical Analysis of the City Plans and Surrounding Areas  
by a GIS Database\***

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This study analyzes the area outside the city walls of the Western Han and Tang imperial capitals of Chang'an. Although there has been considerable historical and archaeological research on the urbanized area within the walls of these two cities, the surrounding areas have not previously been systematically investigated. Through the use of detailed survey maps at a scale of 1:10,000 from the early twentieth century, coordinated with archaeologically documented remains and reconstructed plans of the cities themselves, a Geographical Information System (GIS) has been developed. This GIS graphically indicates the remains of a grid of roadways outside the city walls,

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\* The maps not otherwise credited in this paper are from the author's website for this project, 漢唐長安之城內城外規劃研究, which may be accessed at <http://edugis.rchss.sinica.edu.tw/htchangan/>. For effective use of the site, the web browser should be set to Firefox. All maps in this paper are presented with the traditional "north up" orientation, and so it is not noted on individual maps. For a scale to the maps, please refer to the website, which has a scale that adjusts to the views selected. Financial and technical support for this research has been provided by the Center for GIS of the Academia Sinica and under Grants 97-2410-H-259-045-MY2 and 99-2410-H-259-029 from the National Science Council of Taiwan.

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relating to gateways and major avenues within the cities. The coordination with landmarks from these time periods shows that there was a planned network of roads in this area at least as early as the Western Han, that the Tang city of Chang'an was planned in conjunction with this grid of roadways, and that there are certain areas of of the Tang city where the regular grid of streets and neighborhoods may not have actually been built as shown on the traditional reconstructions. The GIS will be available on line for public access.

Keywords: Chang'an, Han dynasty, Tang dynasty, GIS, Geographical Information System, roads, maps

## Introduction

This paper considers how space, or to be more precise, the space of the man-made landscape, was physically arranged in the area that surrounded the walled cities of the imperial capital, Chang'an, during the Han and Sui-Tang dynasties. This analysis is based on a Geographical Information System (GIS) database that enables a tentative differentiation between the traces left from these two time periods. Based on this, I discuss the relationship between the layout of the Han and Tang cities, and verify that the road system does indeed date from these early periods. There are several general questions that this study addresses:

First, was there design or planning in this area, and by extension, possibly for other areas outside city walls in early China, including both residential areas and agricultural fields? This question has received little previous attention since, although there has been a great deal of work based on archaeological excavation in the areas within the walls of both large and small cities, there has been very little consideration of the context outside the walls.

Secondly, what was the process of development for the new capital of Sui-Tang Chang'an? This city was extremely important as a model in the development of urban planning, both for China and for areas associated with the Chinese cultural sphere, especially Japan and Korea. To date, the Sui-Tang city has been considered as a completely new city, planned with very little consideration for the pre-existing conditions of its site, though this is an assumption most likely based largely on lack of information about these conditions.

And thirdly, how accurate is our understanding of the actual plan of the Tang dynasty city? Much of our understanding for the way in which the Tang city was laid out is based on a Song Dynasty stone engraving that dates from several

centuries after the Tang city had been laid waste, and was based on sources whose accuracy is not clear to us. The remains of this map show a perfectly regular grid of avenues, streets and alleys. Thus the question of to what extent this plan is an idealization and to what extent it reflects the actual built conditions is critical for understanding the urban design of this city.

## Roadway Typology

To present a context analyzing the historical development of this pattern of roadways, it would be worth reviewing two of the basic roles that roads play in the man-made environment, and how the ways we understand these roles affect the aspects we consider in our historical investigation of the roads. To begin with, the English word, road, denotes two basically different types of communication lines. The first, an *inter-settlement* road, is a linear connection between two different loci. The contemporary epitome of this type of road would be the highway. Over the past five decades or so, this type of road has been extensively investigated for a great many historical cultures, Roman, Middle Eastern, Chinese and others.<sup>1</sup> The second type of road is an *intra-settlement* road that defines the way people organize the space within their towns and cities. This type of road is referred to by many different names: avenue, street, lane, alley, and others. The distinction between these two types is not always clear-cut, but the different types of roadways imply different directions of research. The inter-settlement roads are typically investigated for their general location and how they link cities, as in the *Tang dai jiao tong lu*

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<sup>1</sup> See, for example, Mario Liverani, "Reconstructing the Landscape of the Ancient Near East," *Journal of the Economic and Social History of the Orient*, 39:1(1996), 1-41. David Dorsey, *The Roads and Highways of Ancient Israel* (Baltimore: The Johns Hopkins University Press, 1991). Christopher Tilley, *A Phenomenology of Landscape: Places Paths and Monuments* (Oxford: Berg, 1994).

*kao* 唐代交通路考 study of land communication routes in the Tang dynasty.<sup>2</sup>

In addition to this functional dimension, when the researcher can recreate the experience of travel along a road or the information on land forms is included in a GIS database, the roads can also be considered in terms of the views that would have been experienced by persons moving along these roads, what aspects of the natural landscapes would have been visible, and the implications of these choices of route for the roadway or the artificial manipulation of viewsapes seen from the roads.<sup>3</sup> In contrast, intra-settlement roads can demonstrate how exterior space was organized and thereby provide indications about the process by which the urban matrix developed or the type of social or political structure that led to the creation of such a man-made landscape.<sup>4</sup> This second type of road can help us begin to understand the different sense of time, place and social identity that is embodied in the historical manmade landscapes.

Consideration of the inter-settlement type of roadway has tended to prevail in historical research, especially for areas outside developed urban centers. Laurence, for example, although his study of Roman roads touches on urban centers, considers these roads primarily means to link and define different regions; and when roads enter towns, “what is essential is the assertion of power and cultural values through display.....in order to *impress the visitor and stranger*,”<sup>5</sup> not as part of a strategy to define or order a local space. In this sense, the present study is part of an advance in the current discussion for this

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<sup>2</sup> 嚴耕望，《唐代交通圖考》（臺北：中央研究院歷史語言研究所，1985）。

<sup>3</sup> E.g. J. Barrett, R. Bradley, R. and M. Green, *Landscape, Monuments and Society: The Prehistory of Cranborne Chase* (Cambridge: Cambridge University Press, 1991). D. Wheatley and M. Gillings, “Vision, perception and GIS: Developing Enriched approaches to the study of archaeological visibility,” in G. Lock, ed. *Beyond the Map: Archaeology and Spatial Technologies* (Amsterdam: IOS Press, 2000.)

<sup>4</sup> 貝克定(Timothy D. Baker, Jr.)，〈西漢人造環境：官僚的空間與文人的環境〉，收入國立政治大學中國文學系主編，《漢代文學與思想學術研討會論文集》（臺北：國立政治大學中國文學系，2007）第6冊，頁301-314。

<sup>5</sup> R. Laurence, *The Roads of Roman Italy: Mobility and Cultural Change* (London: Routledge, 1999), 161. (italics mine)

area of research.

## Historical Development of the Chang'an Urban Matrix

The formation of road networks surrounding Chang'an is closely related to the political history of this city. Prior to the Han dynasty, this area was the location of the capital for the state of Qin, and the First Emperor of the Qin dynasty developed his imperial capital at Xianyang, to the west of the Han city, after his unification of China. But a perimeter wall was never constructed around that city and much of the urban fabric was destroyed at the fall of the Qin.

The founder of the subsequent Western Han dynasty, Liu Bang, then selected this site for his imperial capital, reusing some of the palace buildings remaining from the Qin.<sup>6</sup> This city also remained un-walled until the reign of his successor, Hui Di (194-187 BCE), when an irregular, approximately square wall was built that included the existing palace compounds, areas for administration or the military, the regulated markets and a number of residential wards. Over the first half of the Western Han, the palace and government buildings expanded until they occupied fully one half the area of the walled city, and large areas outside the walls were also devoted to imperial compounds. When the Western Han was replaced in 9 BCE by Wang Mang's brief Xin Dynasty, the new emperor also requisitioned areas outside the city walls, in particular for his grandiose complex of imperial ancestral temples. With the population of Chang'an expanding throughout the period of the Western Han, at the same time that the city within the walls was being filled up by imperial compounds, areas outside the city walls must have been used for residential districts.

But the question of the extent of these living areas and how they may have

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<sup>6</sup> 王學理，〈從秦咸陽到漢長安的城制重疊(上、下)〉，《文博》，上(西安，2007.05) 頁4-10；下(西安，2007.6)，頁4-10。

been arranged has not previously been addressed, primarily due to the lack of information on these areas. Although satellite cities developed around some of the imperial mausoleums that were situated to the north, in a line along the opposite side of the Wei River, there is little known about developments surrounding the city directly outside the walls, aside from an imperial palace compound built by Wu Di to the west of the city and several ritual complexes to the south of the city, as discussed below. Following the fall of Wang Mang and his interim dynasty in 21 BCE, the capital of the Eastern Han was relocated eastward to Luoyang, though Chang'an became an off-again-on-again capital for the states that arose during the period of instability after the fall of the Eastern Han.

With the reunification of China under the Wei dynasty, a new, much larger and more clearly organized imperial capital was planned, about 2 kilometers to the southeast of the walls remaining from the previous Han capital, and construction had gotten underway before the Tang replaced the Wei as rulers of a unified China. But the Tang capital remained in this new and as yet unfinished city, with the vast residential wards that lay within the city walls only being gradually built up and occupied as the dynasty went on. After the fall of the Tang, the city was largely left as a wasteland and there followed an extended period of decline and stagnation that lasted until the middle of the twentieth century. Since there was so little urban growth over this period of more than a millennium, the walls for the much smaller city that were built during the Ming dynasty were preserved essentially intact to this day, and the area outside the walls remained farmland dotted only with small villages until urban development with a quickening pace began in the late 1950's.

## Source Materials for the Plans of Han-Tang Chang'an

To provide information on the spatial arrangement of this area as it existed in

early China, there are several types of sources. The most direct indication is early visual images, the most useful of which is a map of the Tang city that was engraved on stone during the Song dynasty, several centuries after the Tang city itself had been destroyed (Fig. 1).<sup>7</sup> Although less than half the fragments survive, the regularity of the city plan shown here, combined with detailed literary descriptions from other sources, has been the basis for all the subsequent historical reconstructions of the city plan. The plan is most complete at the upper, or northern end and it shows the southeast corner of the Han dynasty walls in its upper right hand portion, though there is no indication of the roads that may have existed between the two cities during the Tang.

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<sup>7</sup> For discussions of the map from this stele, see, 路遠, 〈北宋時期長安古碑的兩次劫難〉, 《文博》(西安, 1965.05), 頁64、65、83。王寧, 〈宋呂大防《長安圖》及其地圖學分析〉, 《西安文理學院學報(社會科學版)》, 2010年第3期(西安, 2010.05), 頁36-39。



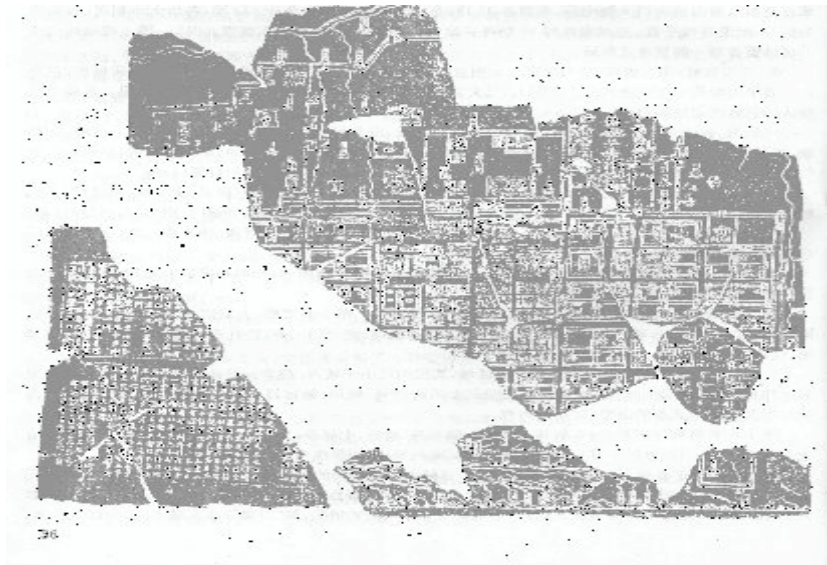


Figure 1. Song dynasty map of Tang Chang'an. Remains of Han walls shown in upper right corner, Tang imperial city in upper center with residential wards and markets below, hills and park in lower left corner. (劉家信,〈宋碑長安圖考〉,《地圖》,1992年第4期(西安,1992.04),頁36。)

The second type of source material is literary descriptions. From the Han dynasty we have the section on historical geography in the *Shiji* “Treatise on Rivers and Canals” 《史記·河渠書》, poetic descriptions in Ban Gu’s “Fu on the Two Capitals” 《班固兩都賦》, and geographical information in the *Hanshu* “Treatise on Geography” 《漢書·地理志》. There are also several collections that organize literary information pertaining to these two time periods of Chang’an, including the *San fu huang tu* 《三輔黃圖》, the *Chang’an tong shi* 《長安通史》, the *Chang’an zhi* 《長安志》, or the *Shui jing zhu* 《水經注》. These collections provide fairly detailed information on the activities that took place within Han and Tang Chang’an, including the names of wards, avenues, and gates; where notable individuals or architectural monuments were located; and descriptions of the palace compounds.

The most reliable type of information is, of course, that provided by

archaeological excavations; and the excavations of use to this study are mostly for sites from Han Chang'an, since the area surrounding the city at this period was less affected by urban development of the twentieth century. The Han walls, gates and major palaces have all been located, with more detailed excavations taking place in a few areas (Fig. 2).<sup>8</sup> One important excavation of a specific site is the Wang Mang Nine Temples (Wang Mang Jiumiao), which provides an important indication of how space was arranged outside the city walls (Fig. 3).<sup>9,10</sup> But it is limited to the arrangement of buildings within a walled compound and, apart from its location, gives little information as to the spatial context. There have been a number of tombs excavated from periods after the Han, two Tang pagodas remain intact, and the main archaeological excavation that would begin to provide information on the Tang urban context is the palace complex of the Daming Gong, which protruded to the northeast of the walled city.

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<sup>8</sup> 劉慶柱，〈古代都城與帝陵考古學研究〉（北京：北京科學出版社，2000）。

<sup>9</sup> 中國社會科學院考古所編著，〈西漢禮制建築遺址〉（北京：文物出版社，2000）。

<sup>10</sup> 劉瑞，〈漢長安城南郊西漢社稷建築初探〉，《咸陽師範學院學報》（咸陽，2007.01），頁1-8。

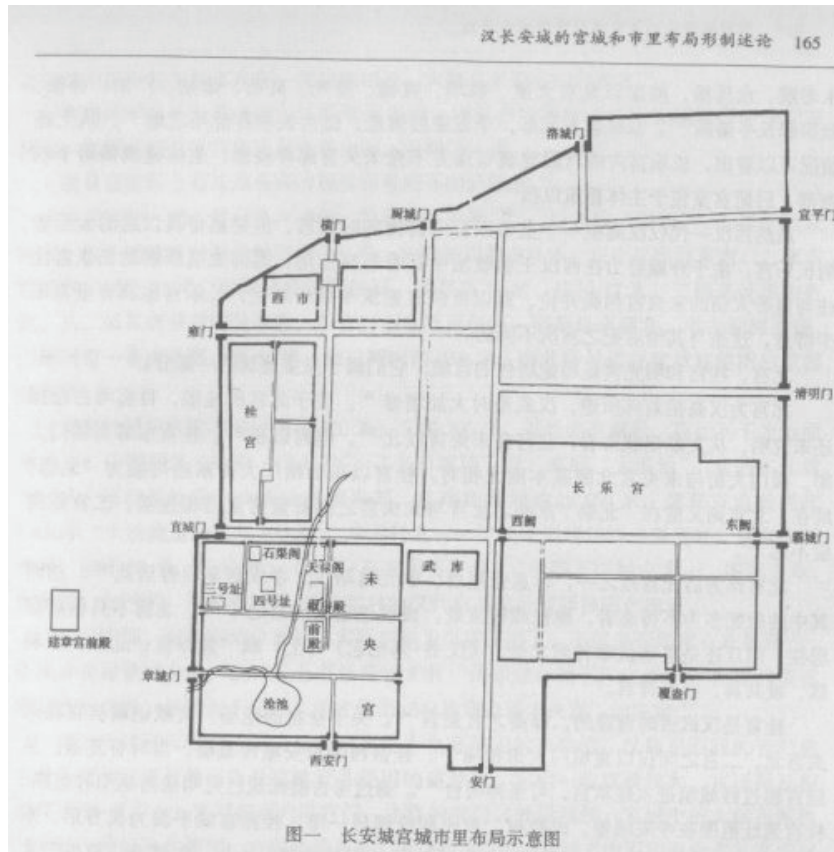


Figure 2. Archaeological plan of Han Chang'an. (劉慶柱, 《古代都城與帝陵考古學研究》(北京:北京科學出版社, 2000)。)

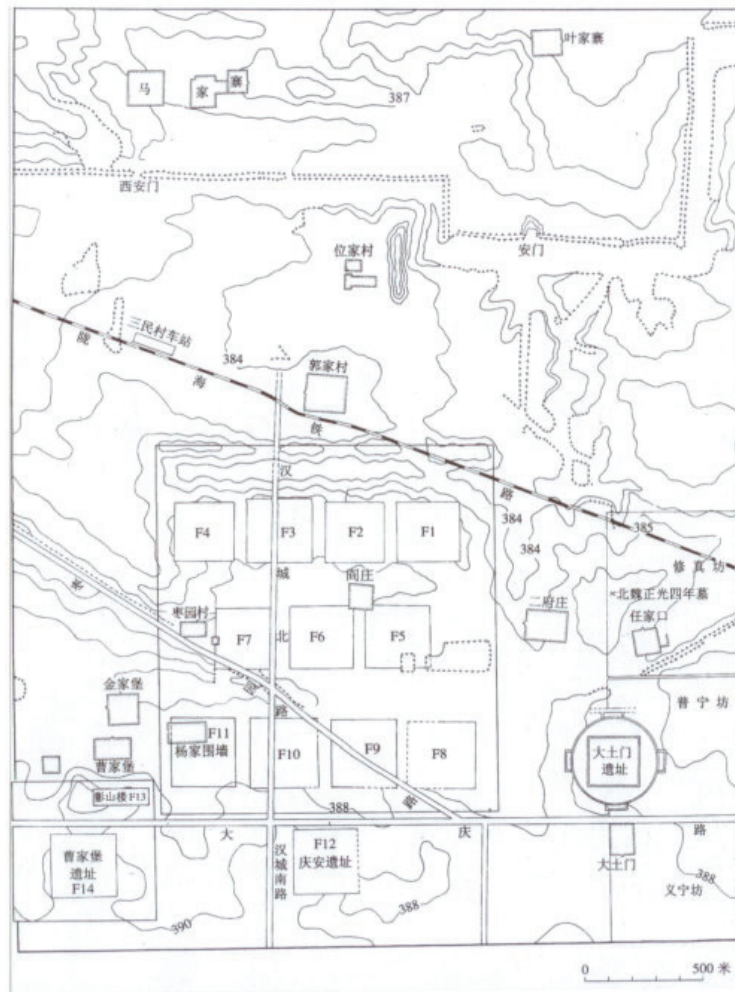


Figure 3. Wang Mang Nine Temples. The twelve numbered squares indicate the ancestral temples within this complex. (中國社會科學院考古所編著，《西漢禮制建築遺址》(北京：文物出版社，2000)。

Combining these three types of information are three generations of historical reconstructions, all of which are concerned only with the Tang city.

The primary reconstructions are those of Shi Nianhai 史念海 (Fig. 4),<sup>11</sup> Victor Xiong (Fig. 5),<sup>12</sup> and the three-dimensional digital reconstruction of Heng Chye Kiang 王才強.<sup>13</sup> These combine the textual descriptions, complete the grid indicated on the Song stele, and incorporate archaeological finds within the city walls. But they provide essentially no information about the area beyond these walls.

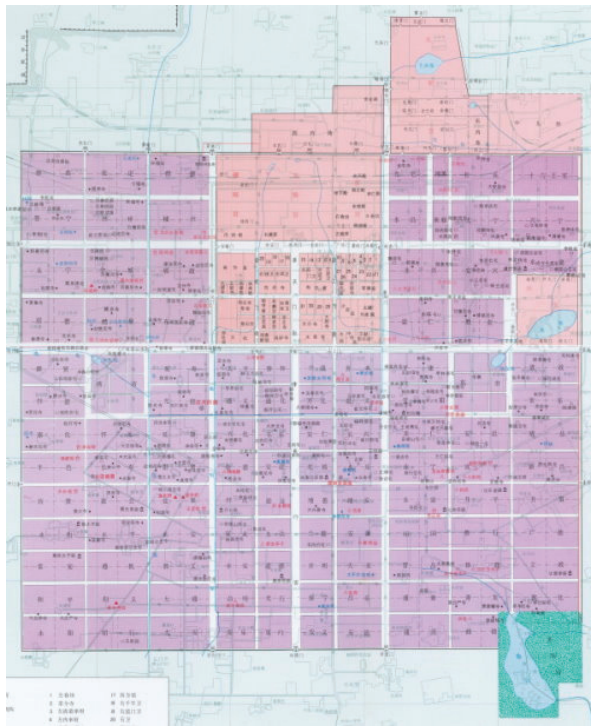


Fig. 4. Historical reconstruction of Tang Chang'an.  
(史念海, 《西安歷史地圖集》(西安: 西安地圖, 1996)。)

<sup>11</sup> 史念海, 《西安歷史地圖集》(西安: 西安地圖, 1996)。

<sup>12</sup> Victor Cunrui Xiong, *Sui-Tang Chang'an: A Study in the Urban History of Medieval China* (Ann Arbor, MI: Center for Chinese Studies, 2000).

<sup>13</sup> 王才強, 《唐長安的數碼重建》(北京: 中國建築工業出版社, 2006)。

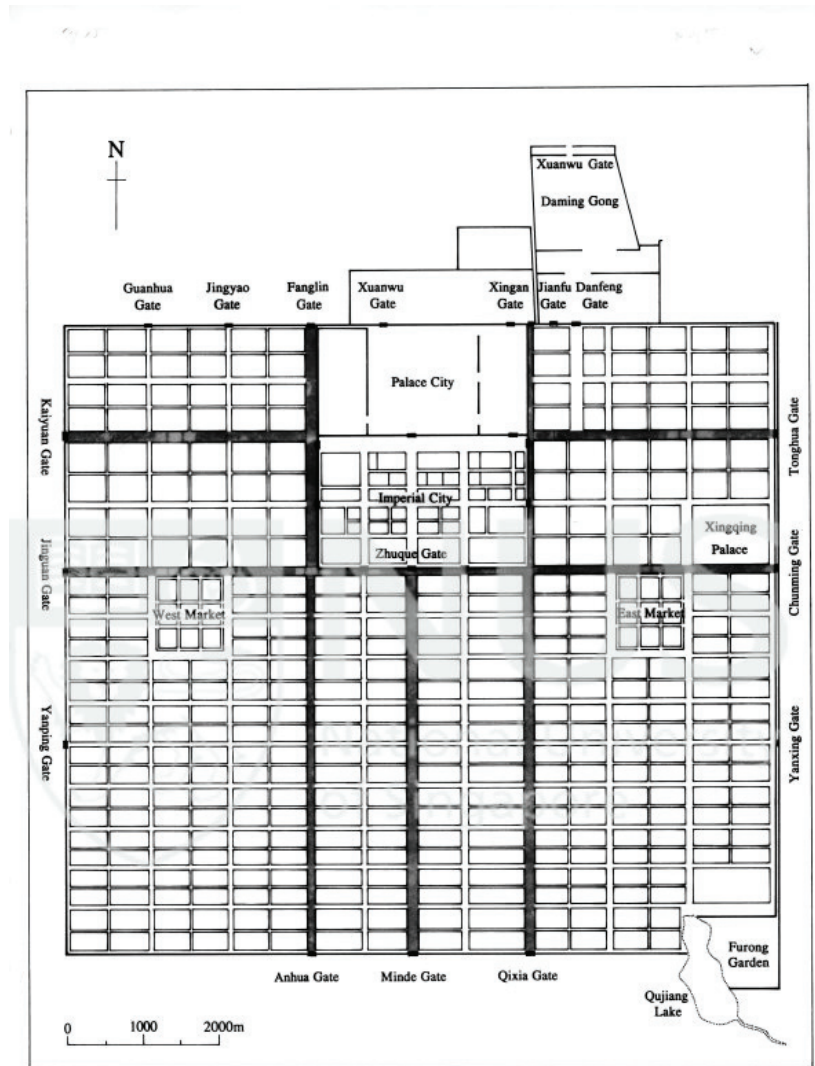


Fig. 5. Historical reconstruction of Tang Chang'an. (From Victor Cunrui Xiong, *Sui-Tang Chang'an: A Study in the Urban History of Medieval China* (Ann Arbor, MI: Center for Chinese Studies, 2000).)

An additional source of information for the spatial arrangement of areas beyond the city walls in early China is a series of detailed survey maps that were prepared beginning in the early 1930's (Fig. 6). Although the maps are highly accurate, showing all of the roadways and paths, as well as topographic contours at one-meter intervals they have received relatively little attention for the study of early China, aside from an article by the historical geographer Frank Leeming.<sup>14</sup> By examining a large number of these maps for many areas of China, Leeming concluded that traces of an earlier rectilinear grid of roads indicated an organized pattern of roads that had existed at least as early as the *juntian* 郡田 system of land division that was introduced in 485 CE under the Northern Wei.<sup>15</sup> Moreover, he speculated that this grid was likely to have had its origins in the much earlier *jingtian* 井田 system of land division mentioned during the pre-Qin period;<sup>16</sup> though the degree to which this principle of agricultural land planning had actually been implemented, instead of being simply a social ideal, has long been a issue of debate. His proposal for the indications of the *zhuntian* system is quite specific, finding confirmation of it in the dimensions of the traces of roadways as well as the pattern of the grid, and his conclusions regarding earlier periods, including the Han, are more reserved. And overall, the general observation that certain areas of China within the coverage of these survey maps show clear indications of a rectilinear grid pattern, while others show no indication of it, supports his conclusion that these traces are not random patterns, but are rather indications of a deliberate planning for areas outside city walls.

Though research did not continue in the direction indicated by Leeming, similar but independent research has been done in northern France. There, 19<sup>th</sup> and early 20<sup>th</sup> century cadastral maps showing property boundaries in

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<sup>14</sup> Frank Leeming, "Official Landscapes in Traditional China," *Journal of the Economic and Social History of the Orient*, 23 (1980), 153-193.

<sup>15</sup> Frank Leeming, "Official Landscapes in Traditional China," 161.

<sup>16</sup> Frank Leeming, "Official Landscapes in Traditional China," 171.

agricultural fields have been used to indicate the traces of Roman property division. As with the case of China, a more regular scheme of land planning from two thousand years previous can be discerned within the less regular medieval land divisions.<sup>17</sup>

In this project, I use maps that were part of the same type used by Leeming, but prepared at a larger scale, 1:10,000 instead of the 1:50,000 or 1:100,000 scale maps he used.<sup>18</sup> These were printed earlier than the 1:50,000 maps and apparently acted as the base from which the smaller scale maps were prepared with reduced information. These maps are highly detailed, showing roads, lanes, pathways, elevation contours at one meter intervals, as well as the remaining city walls of Han Chang'an and the imperial Han tombs (though these are mostly outside the area considered in this study) and other archaeological features known at the time. The maps comprise an invaluable source of information on early China since the areas they cover have been drastically altered by development since the 1960's and the roadways they show are now almost entirely obliterated.

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<sup>17</sup> P. Jacques, "Temoin de casastres romain dans la region de Cassel," *Revue du Nord*, 69:272 (1987), 101-108. E. Malavache, and G. Pouchain, "La recherche ses casastres antiques dan la region Nor-Pas-de-Calais, " *Revue du Nord, Archaeologie*, 76:308 (1994), 83-98.

<sup>18</sup> The maps for this project were obtained from the Harvard University Map Library. Each of the quadrants is individually marked with the individual dates on which it was surveyed, drawn and printed.



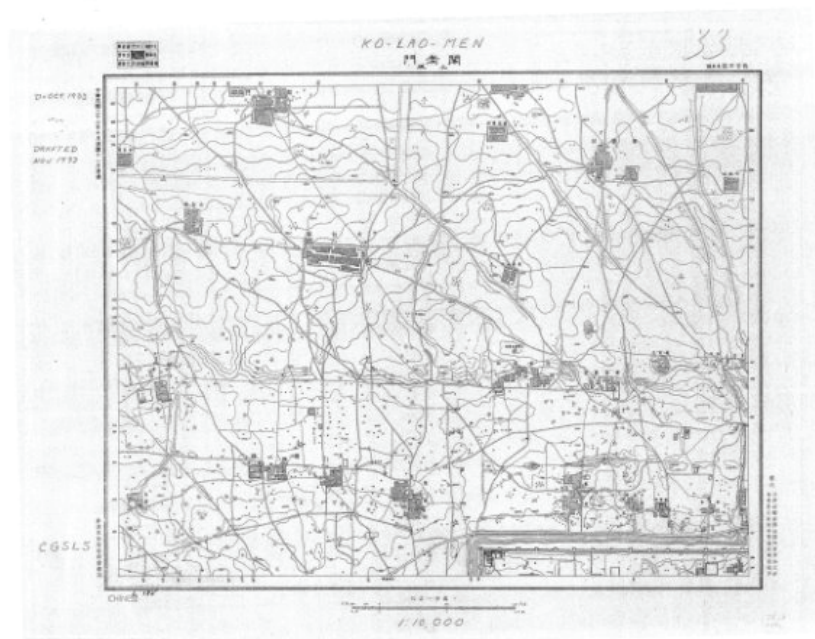


Figure 6. Survey map showing the southwest corner of the Han city wall and the Northwest corner of the Ming city wall. The line of the northern Tang wall is indicated by the change of contour lines half-way between the two.

## Analysis of Information from the Survey Maps

That these traces of roadways conform to an earlier roadway system is indicated first by the fact that many of the roadways are aligned with the gates of Han Chang'an, which were not significant determinants for a roadway system after the shift of the capital site southeast to the Sui-Tang site. Many of these roadway traces indicate their continuity by breaking off and then picking up the same alignment at some distance away. Furthermore, the traces of

roadways are also aligned with grading cuts through steeper terrain to permit the passage of a roadway, as shown by the contour lines, and in one example aligning with one of the Han dynasty city gates (Fig. 7).



Figure 7. Survey map showing contour cuts (indicated by heavy black lines) for roadway south of Han Chang'an not indicated by roadways on the survey map.

But despite the evidence presented by these maps, there were several questions regarding this proposal. The first was the simple question as to whether a construction so elementary as a rammed earth roadway could present its traces as long as two thousand years after its construction. The second, and more significant, question was when these roadways dated from: the Han, the Tang or some other period. The basic question of whether a structure so humble as a dirt road could have survived for two thousand years can be considered in the light of research in other areas such as England, the Middle East on the traces of earthen roads remaining from the Roman period visible as foot paths or divisions between fields.<sup>19</sup> But in this site, the more serious question was how much of this system dated from the Han, how much from the Tang, or were they from later periods?

To answer this question, it was necessary to develop a GIS database that could incorporate the information from different time periods so it could be analyzed. Since the original survey maps did not have longitude or latitude references, we first located the digitized survey maps over Google earth to provide geographic coordinates and to allow this to be integrated with the Academia Sinica historical GIS so in a few months from now it can be accessed through that website. On top of this base we located the other sources of information such as the Han archaeological plans and historical reconstruction of the Tang city. In order to actually see and work with these layers together, it was necessary to trace out all of the roadways and paths that were indicated. This was a considerable task, and when it was finished the roadways from the 1930s survey maps presented a dense maze of lines surrounding the organized grid of the Ming dynasty city (Fig. 8).

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<sup>19</sup> See D. Dorsey, *The Roads and Highways of Ancient Israel* (Baltimore: Johns Hopkins University Press, 1991).

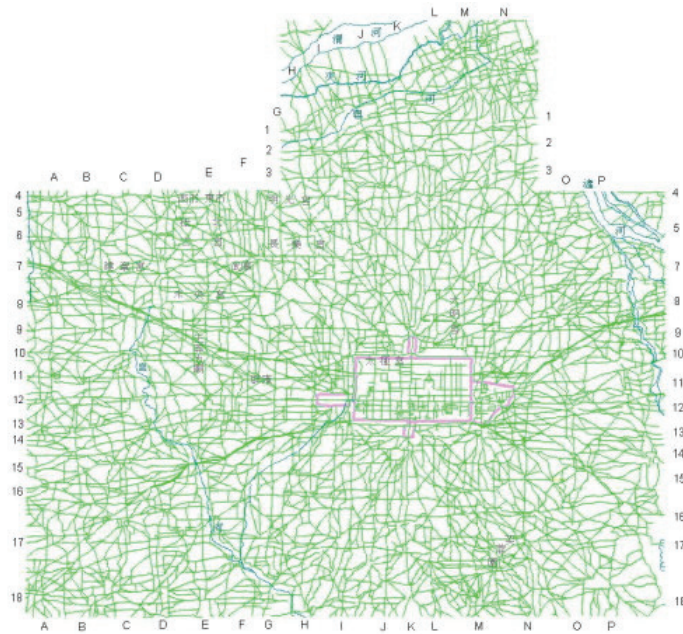


Figure 8. Roadways from survey maps plotted in GIS system. Ming dynasty city walls shown for reference.

But when this maze is examined more closely, there are indications of an early roadway grid that are even clearer than that seen by Leeming in his smaller-scale maps. In the GIS database, the 1930's roadways are shown in green overlaid in yellow by what I propose to be the Han or Tang grid of roadways, while dots indicate a connection between roadways of this grid where there was no trace of the earlier roadways on the survey maps. I have given the EW roadways numbers and the NS roadways letters as a means to designate locations by coordinates. There are a few places where the roadways are not continuous from one side to the other, but in general, the continuity is quite surprising. The connection of a roadway over gaps both short and long is another indication that there was originally a continuous grid. We could look, for example, in the area to north of both the Han and Tang city walls, at

roadways 1 from I to J, roadway 2 from M to N, roadway 3 from I to M.

Although there generally a regular dimension to this grid of about 1 km, we can also notice that there are places where there appear to be two roadways close to and parallel to one another. For example roadways 10, 11, 12 and 13 to the east of this area show a green line to the south of the yellow line showing the proposed early roadway. I will explain this below.

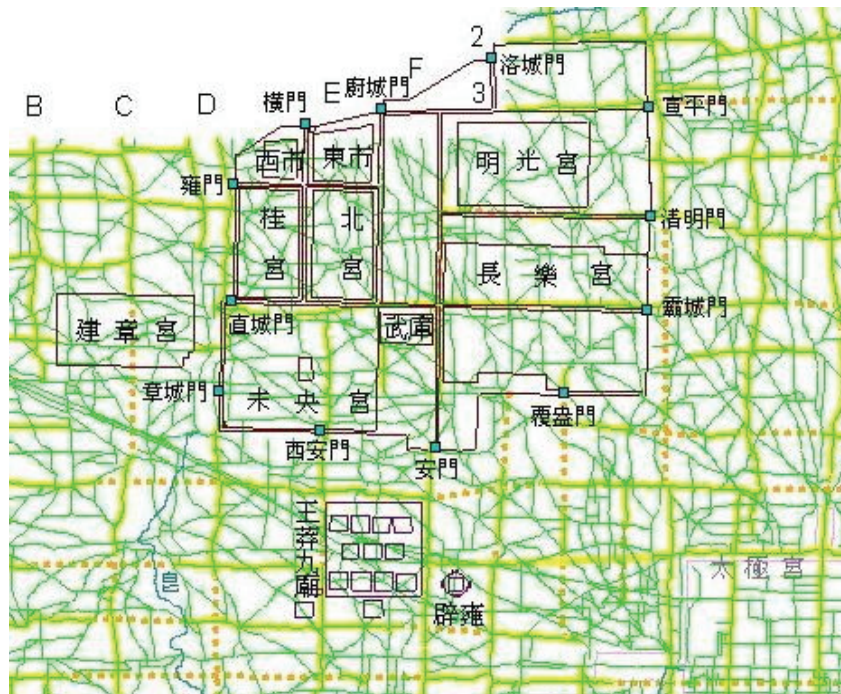


Figure 10. Han dynasty archaeological plan plotted on GIS map with Han dynasty roadway grid shown in yellow.

On a detail of this map we can see the Han city and the main structures outside the city walls (Fig. 10). The three eastern and southern gates all have roadways part of the grid system leading outwards. The survey map that covered most of the area of the northern wall was missing from the library

collections that I checked,<sup>20</sup> but it can be seen that the area of the city walls fits into this grid. We can also see that the Wang Mang Jiumiao is located between two of these main roadways leading south, with the Biyong/Mingtang 辟雍／明堂 and the Altars of Earth and Grain to either side of the avenues. It appears that one of the east-west roadways was interrupted, probably due to the large size of this complex, though the fact that there was a roadway in this location on the survey maps indicates that this early grid roadway was reinstated after the Jiumiao was leveled in the insurrections following the fall of Wang Mang. We can also see another roadway that crosses the Jianzhang Gong 建章宮 palace-park west of the city; but since there has been very little archaeological excavation of this complex, we cannot say whether these major roadways were retained in place after the walls were constructed or whether the roadways were re-established in their original location when these palaces were taken down to provide materials for the Wang Mang Jiumiao.

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<sup>20</sup> Harvard University Map Library, Library of Congress Map Library. However, the map quadrant covering this area was subsequently found and it will be added to the maps on the website referred to above.



Figure 11. Reconstructed plan of Tang Chang'an with Han dynasty walls and Tang dynasty roadway grid in yellow.

Plotting the plan of the Tang city from the reconstruction by Shi Nianhai, we see the plan of the Tang city based on the Song dynasty map, together with the outline of the walls for the Han city, which remained after the Tang city was built and, unlike the Tang walls, survive in large measure today (Fig. 11). The gates in the Tang perimeter wall have roadways leading out from them and many of the main avenues of the Tang city are part of the grid as indicated by roadways from the survey maps (Fig. 12).



Figure 12. Reconstructed plan of Tang city showing relationship between city gates and Tang dynasty roadway grid.

By comparing the Tang plan with the Han plan, we can make further deductions about the differential dating of some of these roadways. For example, If we look at the northern gate in the western Tang wall, the Kaiyuan Men 開遠門, we can see a roadway that leads west directly from this gate. We can also see a road to the south of this, which is not highlighted; and on the grid for the Han period, it is this southern roadway that is highlighted since it lies just to the south of the perimeter wall for the Wang Mang Jiumiao as part of the proposed Han roadway system. As such, it appears that the roadway grid that existed in the Han period was adjusted in some locations in order to align with the more regular plan of the new Tang city. Moreover, the road that had been



realigned due to the regular Tang plan was extended into the area surrounding the city walls, although the road remaining from the Han period may have continued to have some use since its position is still indicated by a roadway on the survey map.

Looking more closely at the Tang city plan, the roadways bring up some interesting questions. The location of the main avenues, as confirmed by what I propose to have been as the earlier grid, generally agree with the reconstructed plan, though perhaps somewhat less in the hilly southeast area of the city. In this area, roughly between reference lines L – N and 15 – 16 on the GIS plan, the terrain is distinctly hilly and broken up by small ravines. The fact that there were essentially no indications of roadways following the orthogonal grid in this area is a strong indication that it was not actually developed as the Song dynasty stele and subsequent reconstructions indicate. Had avenues existed in this area, they would have required modifications of the grading. Though this would not have been a difficult task, as indicated by the fact that a Han dynasty avenue cut across a hill, as discussed above, if there had been modifications of the terrain, the roadways would have been much more likely to remain in their original position, leaving traces on the survey maps. There are various possibilities for how this area might have been used if it was not part of the regular street grid: it may have been simple a less orderly residential area, have had large compounds for monasteries, or contained park land in addition to the area shown as park land on the Song map. Without further archaeological work, it is difficult to speculate further.

But in addition to the main avenues shown on the city plan, each of the walled residential wards that was bordered by a main roadway is recorded as having one east-west and one north-south road that divided the ward into four equal quadrants. These lanes are also shown on the Song stone engraving. There is some indication of these intermediate lanes in the existing roadways,

particularly along lines G and H,<sup>21</sup> though these indications do not appear to be centered on the grid of the wards. This may be attributed to the fact that there was a roadway remaining from the Han close to this location that was reused for the Tang city since an interior lane being off-center would not have been a major fault that merited relocating a pre-existing roadway in the new Tang city. The fact that in these areas it is the minor lanes that can be seen reflected on the roadways of the survey maps may be due to the fact that these locations were part of the larger grid that extended outside of the city. Thus they may have been more likely to be used and so more likely to be preserved after the Tang city had been destroyed. But overall, it appears that the Tang city was, at least in its main avenues, as regular as the Song plan indicates, and that this regularity was in large part based on a grid of streets that had been in existence during the Han. In effect, it was a regular city that was developed around a previously existing matrix of roadways, using these roadways selectively and making adjustments to them in cases where they were necessary to preserve the regularity of the new city plan.

## Summary

In response to answer the questions initially proposed in this paper, we can see make three points:

First, in terms of the existence of large-scale and detailed planning, for the area under investigation, this investigation demonstrates its existence in this regional site. Beginning at least as early as the Han and extending through at least the Tang, the capital city of Chang'an, as organized within its perimeter walls, was an integral part of a continuous spatial matrix that spread out from

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<sup>21</sup> Roadway grid lines G and H are shown on Figure 12. To see the relationship between the roadways that these lines are based on, and the lanes within the residential wards, it is necessary to refer to the website mentioned above.

the city to the surrounding countryside clearly for a distance of five to ten kilometers. In addition, according to indications on the smaller-scale 1:50,000 maps available for this area (not shown here), this spatial matrix may also have included the area to the north of the Wei River, which was the location for the tombs of most Western Han emperors, together with the satellite towns established to support these tombs. Although this broader context has not yet been systematically investigated, it appears that the grid of roadways to the north of the river was shifted slightly counterclockwise to better align with the slope of the land on that side of the river.

Secondly, the planning for this large-scale organization was carefully tailored to accommodate various existing conditions. The grid of roadways was adjusted to align with the gates of the city walls and the major avenues within the walls for both the Han and Tang cities. This grid of main streets was the framework that organized the growth of the capital outside the city walls during the Western Han. It also appears that the new Sui-Tang capital was developed based on this grid of roadways, rather than being developed as a completely new city on a blank slate. Then after the fall of the Tang, with the economic decline and reduced population of this city, the grid of roadways was gradually abandoned, leaving only its traces in the lanes and pathways of the countryside and in the regular grid of the small Ming dynasty city layout and its walls.

Lastly, it can be seen that the Song stone engraving and subsequent modern reconstructions of the city plan were indeed accurate in their main outlines. This is confirmed by the fact that the locations of the main streets, indicated by roadways from the survey maps, align with streets of the reconstructed Tang plan. There are, however some areas where the Song plan and the reconstructions may be idealizations. The main area of discrepancy is in the hilly southeast corner of the city, where there is no trace of roadways conforming to the grid shown on the Song plan – or indeed any other grid. In addition, the observation that there are streets which are part of the grid system

but are offset from the central alleyways within the residential wards indicates that these interior streets may not have been as neatly placed in the centers of the wards as shown on the Song plan. The fact that streets which were part of a larger grid system for the area outside the Han city walls, a grid that had persisted from the Han to the Tang, were re-used to locate the smaller lanes within the wards is a further indication of the point above, that the city planning was adjusted to accommodate existing roadway locations where possible.

One important question, however, that this investigation has not been able to effectively address is: just when did this grid originate; was it created during the early Western Han, as the capital itself developed? That is to say, was it established based on major roadways that were extended out from the walls of the Han city, or was this grid already in place during the Qin, so that the Han city walls were merely wrapped around a small portion of this grid when the new imperial capital was established? Although we have little archaeological evidence to indicate how the Qin capital of Xianyang was laid out, the earlier origin to this grid may be more likely. For one, although the street layout of the Han capital within its perimeter walls is rectilinear, it does not maintain a continuous and regular grid. This is in striking contrast to the regularity and continuity of this grid to the east, south and west of the Han city. In addition, the Han city walls appear to be located on a more ad-hoc basis, without the careful planning needed for an extensive grid system. But more conclusive discussion of this question must await further archaeological findings for the roadways themselves and remains from the pre-Han period.

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## 漢唐長安的城內城外空間結構： 古代城郊佈局的地理資訊系統(GIS)分析

貝克定

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本研究分析了西漢和唐朝的首都長安高牆外的地區。針對兩朝城牆內城市化地區所做的史學與考古學研究成果雖然已經非常豐碩，然而周邊地區卻尚未受到充分系統化的探討。透過使用自二十世紀初葉開始以一比一萬比例所做的精細測量地圖調查，結合保存下來的地理史料和建築計畫書，一個地理資訊系統(GIS)於焉誕生。這個系統指出貫通城外與城內，並將門道與大街連為一體的棋盤式道路構造。藉由比對兩個朝代的標地可以發現，這種道路網絡至少在西漢時期便已經存在，唐代長安城的新城市設計則是繼承了這個棋盤式的街道布局，而該城又確實有一些在傳統重建上存在的區塊，可能實際上是沒有如此動工過的。這件 GIS 很快便會開放提供給大眾使用。

**關鍵詞：**長安、西漢、唐代、GIS、地理資訊系統、道路、地圖

