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GIS-Based Spatial Reconstruction of Excavated Goryeo Celadons from the Goryeo Palace Site: Based on Gaesong Manwoldae Inter-Korean Joint Excavation Data

Youngjin Chung [1], Hyunju Lee [1], Yunjeong Kim [1*]

[1] Graduate School of Archaeology and Art History, Korea University, 2511 Sejong-ro, Sejong, Republic of Korea – (jyj8582, yourstargen, hanova99)@korea.ac.kr (*corresponding author)

Keywords: Goryeo Celadons, Goryeo Palace, Inter-Korean Joint Excavation Survey, GIS Analysis, Analysis of Spatial Context.

Abstract

This study addresses the limited usability of Goryeo celadon data from the Gaeseong Manwoldae Inter-Korean Joint Excavation. The current Digital Archive for the Inter-Korean Joint Excavation of Gaeseong Manwoldae separates artifact attributes from spatial information, hindering integrated analysis of artifact-findspot relationships and spatial distribution. This research utilizes Geographic Information System (GIS) to overcome this fragmentation. The methodology involved creating an Excel Artifact Attribute Table for 1,089 Goryeo celadon sherds with 28 attributes, including production period and technique. High-resolution site drawings were then georeferenced using ArcGIS, and the attribute data was spatially joined to each artifact's precise excavation location using its unique 'registration number' as a key. This process produced the ArcGIS Artifact Spatial Information Map, an integrated dataset linking artifact attributes with their spatial information. In conclusion, this study establishes a new framework for integrated spatial analysis, overcoming the limitations of fragmented data. The findings are expected to enhance the usability of Manwoldae data, contributing to deeper research on the Goryeo royal court.

1. Introduction

Gaeseong, the capital of the Goryeo Dynasty (918-1392), is a crucial site for researching its royal cultural heritage. However, the division of Korea has limited scholarly access for South Korean scholars, leaving this field underdeveloped. To overcome this, data from the *Inter-Korean Joint Excavation of Gaeseong Manwoldae* (2007-2018) provides immensely valuable material on previously inaccessible royal sites and artifacts.

Following the suspension of on-site investigations in 2018, the excavation's digital data has been made available through the online *Digital Archive for the Inter-Korean Joint Excavation of Gaeseong Manwoldae*, allowing research to continue. *‘Manwoldae’*, the Goryeo Palace site, is key to reconstructing royal culture. In particular, the excavation of the Western Architectural Complex, identified as the royal living quarters, has provided a turning point for the study of royal celadon (Table 1).

While extensive research has identified the primary production sites for royal Goryeo celadon in Gangjin and Buan in the southern part of the Korean peninsula, scholarly access to the main site of consumption—the Goryeo Palace—has been limited due to its location in North Korea. The current Digital Archive for the Inter-Korean Joint Excavation of Gaeseong Manwoldae provides digital data on the site and its artifacts; however, it shows several limitations in visually representing the excavation status of celadon discovered in various archaeological features such as building sites, drainage channels, and yards (Yunjeong Kim, 2024).

Therefore, the objective of this study is to visualize artifacts excavated from the site's spatial context by incorporating digital technologies such as GIS into the Goryeo celadon data from the Inter-Korean Joint Excavation of Gaeseong Manwoldae, creating the ‘*ArcGIS Artifact Spatial Information Map’*. Visualizing a large volume of Goryeo celadon data in conjunction with the excavated archaeological features on a single interface can be considered an effective research method for resolving the accessibility issues that have hindered comprehensive studies of the excavated artifacts and their site context.

Period	Institution	Project
2007-2018	South: Ministry of Unification, Inter-Korea Historian Association North: National Reconciliation Council	《The 1st-8th Inter-Korean Joint Excavation of Gaeseong Manwoldae》(538 days, 390,000㎡)
2012-2023	National Research Institute of Cultural Heritage	Publication of the《Excavation Research Report On Goryeo Royal Palace of Gaeseong, Vols. I-IV》
2018-2020	Inter-Korea Historian Association	《Project to Establish the Digital Archive for the Inter-Korean Joint Excavation of Gaeseong Manwoldae》
Dec. 2020 - Present	Inter-Korea Historian Association	《The Digital Archive for the Inter-Korean Joint Excavation of Gaeseong Manwoldae (Online Archive)

Table 1. List of Research Projects on the Inter-Korean Joint Excavation of Gaeseong Manwoldae

2. Material and Methods

The advancement of digital technology has greatly contributed to enhancing the accessibility of cultural heritage data. However, existing methods for utilizing this data often have limitations. A review of this study's primary datasets, the *Excavation Research Report on Goryeo Royal Palace of Gaeseong, Vols. I-IV* and the data from the *‘Digital Archive for the Inter-Korean Joint Excavation of Gaeseong Manwoldae’*, confirms that attribute information for excavated artifacts and the site's spatial information are managed in separate interfaces.

This data separation makes it difficult for users to holistically understand the contextual information of artifacts in relation to

their space, and it constrains the identification of the semantic relationship between artifacts and their findspots (Figure 1).

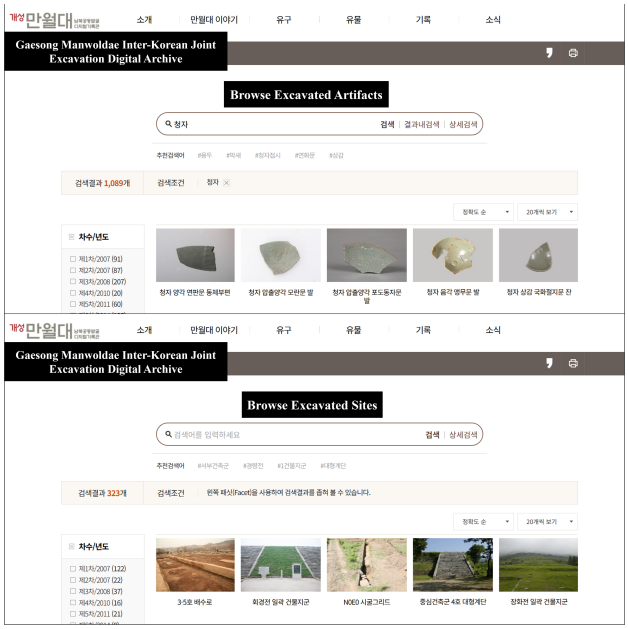

Figure 1. Digital Archive for the Inter-Korean Joint Excavation of Gaeseong Manwoldae

Previous research on Goryeo celadon excavated from Manwoldae has predominantly focused on the analysis of the artifacts themselves, rather than on the spatial context that connects them to the site's characteristics. Therefore, this study introduces a methodology for analysing the spatial distribution of celadon excavated from the site, based on Geographic Information System (GIS). The methodological framework of this study is structured around utilizing Microsoft Excel for building the artifact attribute database and ArcGIS for the integrated analysis of spatial information. These two programs facilitate interoperability through the CSV (Comma-Separated Values) file format, which is widely used for data exchange and compatible with various software. This approach is effective in establishing a visualization environment where users can quickly and conveniently access the desired information. Furthermore, this methodology will serve as a foundation for future research expansion into a 'Platform for Heritage Data Sharing and Collaborative Work' and for more in-depth 'Spatial Documentation and Analysis Using GIS'.

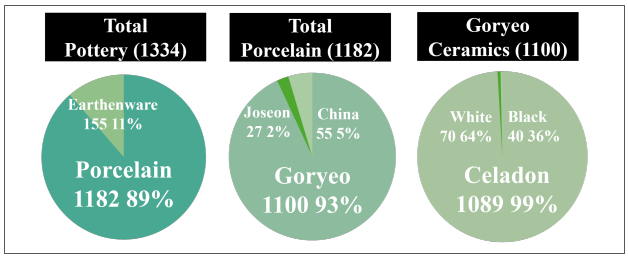

Figure 2. Quantity of Excavated Ceramics from the Western Architectural Complex of the Gaeseong Goryeo Palace

Goryeo celadon was selected as the subject of this analysis. Of the 1,100 Goryeo period ceramic sherds excavated from the Gaeseong Manwoldae site, 1,089 are Goryeo celadon. This number is overwhelmingly greater than the 7 pieces of Goryeo white porcelain and 4 pieces of Goryeo black-glazed ware, identifying celadon as the representative artifact type for understanding the character of the Goryeo Palace. Furthermore, chronological studies of Goryeo celadon have been actively conducted, resulting in a detailed classification system. This system is deemed useful for identifying the distribution patterns and density of excavated celadon by period within the site, as well as for determining the status and operational period of the building ruins (Figure 2).

2.1 Development of the Excel Goryeo Celadon Artifact Attribute Table

The initial step in this research was to construct a comprehensive database of the excavated artifacts. A total of 1,089 Goryeo celadon sherds from the Gaeseong Manwoldae site were selected for analysis. A detailed schema of 28 attributes was established to systematically catalogue each artifact, encompassing crucial information such as production period, vessel type, decorative technique, and findspot details. This dataset was then compiled into a structured table using Microsoft Excel to create the *'Excel Goryeo Celadon Artifact Attribute Table'*, which served as the primary data source for the subsequent GIS analysis.

In conclusion, this study establishes a new framework for integrated spatial analysis, overcoming the limitations of fragmented data. The findings are expected to enhance the usability of Manwoldae data, contributing to deeper research on the Goryeo royal court.

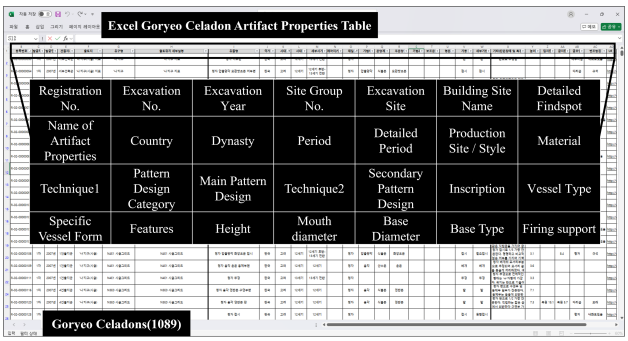

Figure 3. Excel Goryeo Celadon Artifact Properties Table

According to the *Excel Goryeo Celadon Artifact Attribute Table*, a total of 1,089 Goryeo celadon sherds were tallied for analysis. An examination of the excavated quantities by Building Site Group reveals a tendency for artifacts to be concentrated in specific groups, regardless of their architectural area. Building Site Group 6 yielded the largest quantity with 212 sherds, followed by Building Site Group 10 (178 sherds) and Building Site Group 3 (130 sherds). Additionally, relatively large quantities were confirmed in Building Site Group 5 (109 sherds), Building Site Group 8 (97 sherds), and Building Site Group 1 (95 sherds). Other sites included Building Site Group 4 (72 sherds), Building Site Group 7 (66 sherds), and Building Site Group 2 (44 sherds).

In contrast, Building Site Group 9 (16 sherds), where the archaeological features were partially disturbed, yielded a markedly low quantity. There were also 74 artifacts for which a precise findspot could not be identified, having been reported as surface finds or from unknown contexts (Figure 4).

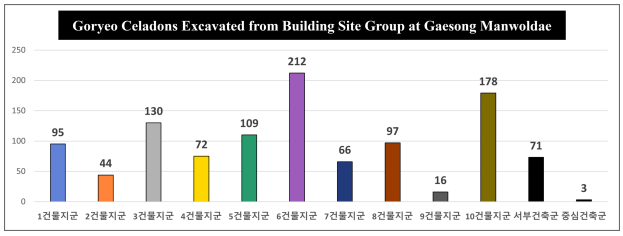

Figure 4. Goryeo Celadons Excavated from Building Site Group at Gaesong Manwoldae

2.2 Developing the ArcGIS Artifact Spatial Information Map

The *ArcGIS Artifact Spatial Information Map* is an integrated dataset created by linking the attribute data from the previously developed *Excel Goryeo Celadon Artifact Attribute Table* with spatial information, allowing for visual analysis and application on a single interface.

The specific creation process is as follows. First, high-resolution drawings of the Gaeseong Goryeo Palace site were converted into the TIF (Tag Image File Format) format using the Illustrator program. Second, using ArcGIS, these converted TIF drawings were georeferenced to satellite imagery, thereby generating a projected map with an accurate coordinate system (Figure 5).

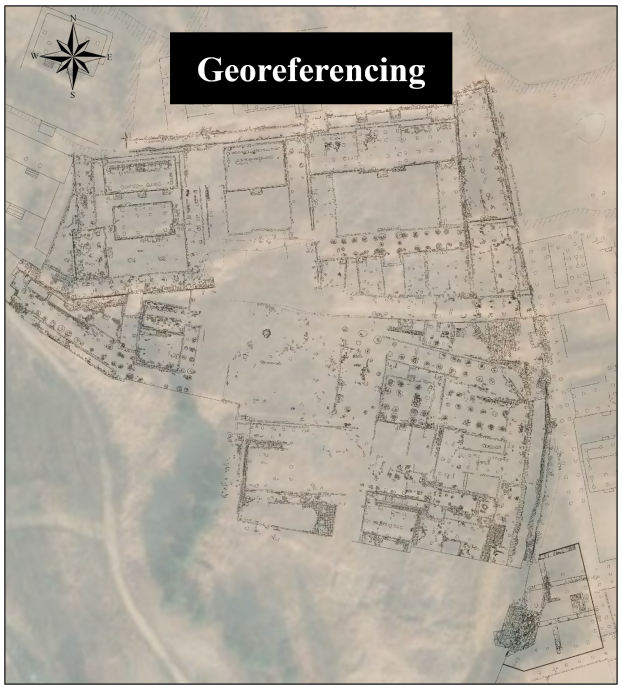

Figure 5. Georeferencing the Gaeseong Goryeo Palace Site Drawings in ArcGIS

Third, the *Excel Goryeo Celadon Artifact Attribute Table* was exported as a CSV (Comma-Separated Values) file.

Fourth, using the 'registration number' assigned by *The Digital Archive for the Inter-Korean Joint Excavation of Gaeseong Manwoldae* as a unique key, the previously converted CSV file was joined to the projected map in ArcGIS (Figure 6).

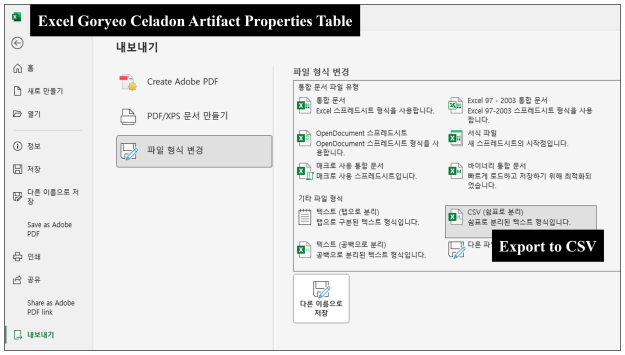

Figure 6. Conversion of the Excel Goryeo Celadon Artifact Attribute Table into CSV format

Fifth, the spatial information for the entire site was finalized by inputting the excavation locations of all 1,089 Goryeo celadon artifacts as point data. The resulting *ArcGIS Artifact Spatial Information Map*, completed through this process, serves as a foundation for conducting multifaceted spatial analyses, such as Kernel Density analysis, and for querying the quantity, distribution, and location of artifacts by building site group and archaeological feature based on the 28 attributes of the excavated celadon (Figure 7).

The process of querying the database using various criteria, established in this study, provides crucial data for determining the period of use for each building site group and identifying their status and character based on changes in the style and decoration techniques of chronologically classified artifacts. In particular, it holds value as a research tool that enables integrated searches on visualized layers through the GIS-based visualization of artifact information—an approach not previously attempted in conventional ceramic studies. The results of this analysis will be described in detail in Chapters 3 and 4.

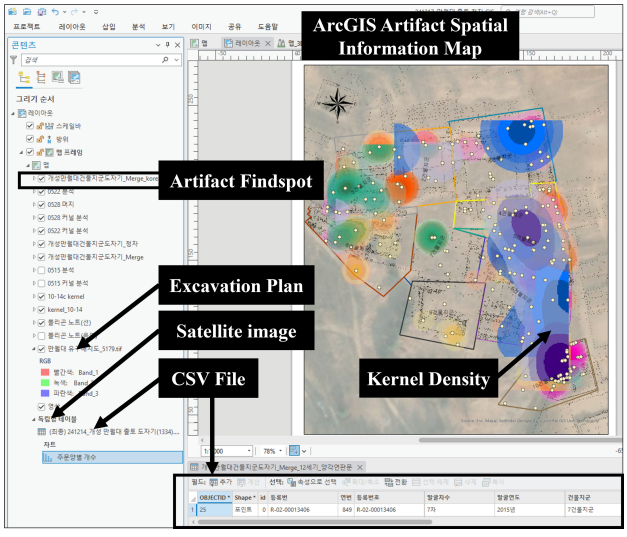

Figure 7. Georeferencing the Gaeseong Goryeo Palace Site Drawings in ArcGIS

3. Data and Result

3.1 Correlation between Celadon Decoration Techniques and Site Usage Periods

To identify the areas of use and the spatial context of the Gaeseong Goryeo Palace's Western Architectural Complex by period, this study performed queries and a Kernel Density analysis using the *ArcGIS Artifact Spatial Information Map*. The analysis revealed a notable correlation between decoration techniques and production periods among the 28 attributes. According to previous studies in ceramic history, the evolution of Goryeo celadon decoration techniques is utilized as a key indicator for determining production periods. Of the total 1,089 Goryeo celadon sherds, 700 had identifiable patterns. The breakdown by technique is as follows: the incising technique, primarily used from the late 11th to the 12th century, accounted for 213 sherds (30.4%); the molded relief technique, centered on the 12th to the early 13th century, comprised 223 sherds (31.8%); the carved and combined relief/incised techniques, from the late 12th to the 13th century, were found on 59 sherds (8.4%); and the inlaying technique, from the 13th to the 14th centuries, was identified on 177 sherds (25.3%). Other techniques included white-painting (19 sherds, 2.7%) and iron-painting (9 sherds, 1.2%) (Figure 8).

The distribution patterns for both technique and chronology showed similar spatial patterns in the Kernel Density visualization, supporting the strong correlation between these two attributes. An analysis of the production periods for all 1,089 Goryeo celadon sherds shows that 12th-century artifacts were the most numerous with 726 sherds (66.6%), followed by the 10th century (82 sherds, 7.5%), the 11th century (84 sherds, 7.7%), the 13th century (124 sherds, 11.3%), and the 14th century (74 sherds, 6.8%) (Figure 9).

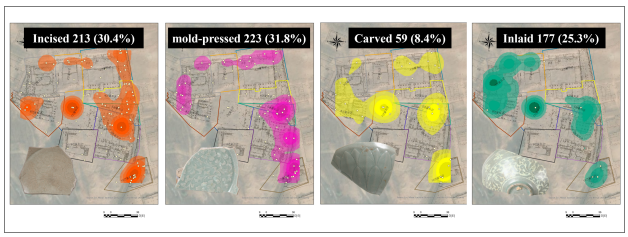

Figure 8. Query and Kernel Density Estimation by Decoration Technique for Goryeo Celadon

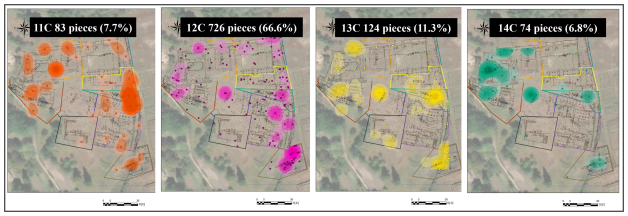

Figure 9. Query and Kernel Density Estimation by Production Period for Goryeo Celadon

3.2 Spatial Context of the Western Architectural Complex based on Excavated Celadon

As a result of the Kernel Density analysis on the entire site of the Western Architectural Group of the Gaeseong Goryeo Palace, the most noteworthy finding is the phenomenon whereby the primary period of use for the building site groups is clearly divided into eastern and western sections based on a specific point in time. Analysis using the *ArcGIS Artifact Spatial Information Map* indicates that the building site groups located in the eastern section (Nos. 1, 4, 5, 6, and 10) were primarily used from the 10th century, the early Goryeo period, to the early 13th century. In contrast, the building site groups in the western section (Nos. 2, 3, 7, 8, and 9) are determined to have been used from the 11th century until the late 14th century, the end of the Goryeo period.

This chronological difference in spatial use can be interpreted through the historical event of the Goryeo-Mongol War (1231-1259). The eastern building site groups, adjacent to the Central Architectural Complex and operational from an early stage, were actively used until the capital was moved to Ganghwa Island in 1231. However, after the court's return to Gaeseong in 1270, the halls destroyed during the war were not restored, and their use appears to have been discontinued. On the other hand, the western building site groups were restored and used continuously after the return, leading to a concentration of artifacts from the later period (Jiyoung Park, 2020). In conclusion, the *ArcGIS Artifact Spatial Information Map* intuitively demonstrates the historical fact that the usage patterns of the Gaeseong Goryeo Palace changed significantly with the Goryeo-Mongol War as a turning point, as evidenced by the distribution patterns of the excavated artifacts (Figure 10).

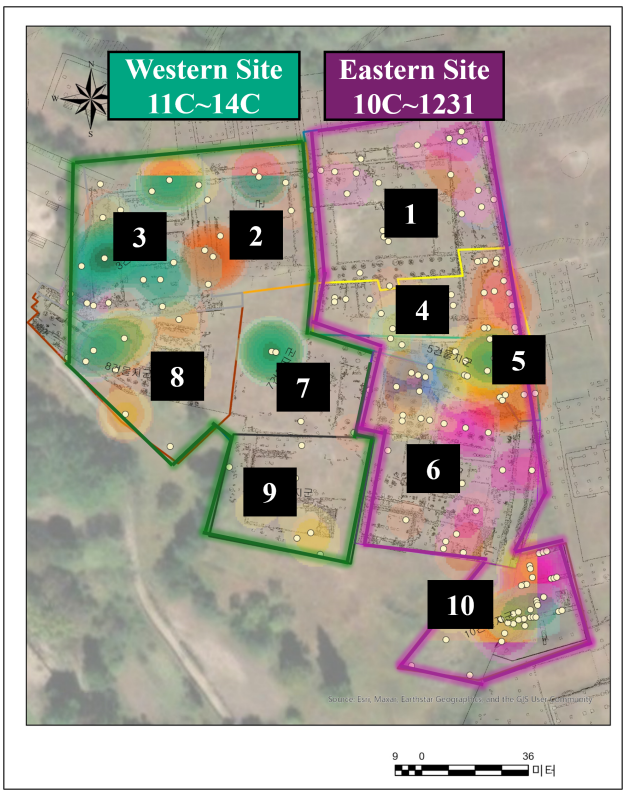

Figure 10. Areas of Building Site Groups Categorized by Period based on the Production Period of Excavated Celadon

The next noteworthy result, observed when overlaying the Kernel Density for the entire site, is that the Goryeo celadon of the building site groups shows a tendency to be concentrated in the outer building features rather than in the central halls. Furthermore, concentration patterns suggesting deposition from nearby buildings were identified in features like drainage channels, and high densities were also present along circulation routes such as corridors and stairs. These distribution patterns indicate that within the Goryeo Palace, the primary spaces for ceramic use and their circulation paths tended to be concentrated in the outer building features (Figure 11).

As demonstrated, Kernel Density analysis using the *ArcGIS Artifact Spatial Information Map* enables multifaceted spatial analysis, making it possible to infer the connectivity between findspots of Goryeo celadon with similar attributes, the range of use during specific periods, density by archaeological feature,

and even paths of circulation. This utility can provide visual research data on the connectivity between artifacts and sites, such as determining the period of use for each building site group based on the stylistic and technical developments of chronologically classified artifacts, and in turn linking this to their status and character. This study is significant in that it presents a new research methodology for searching and analyzing vast amounts of Goryeo celadon artifact information by integrating it with excavated sites as visual layers in GIS.

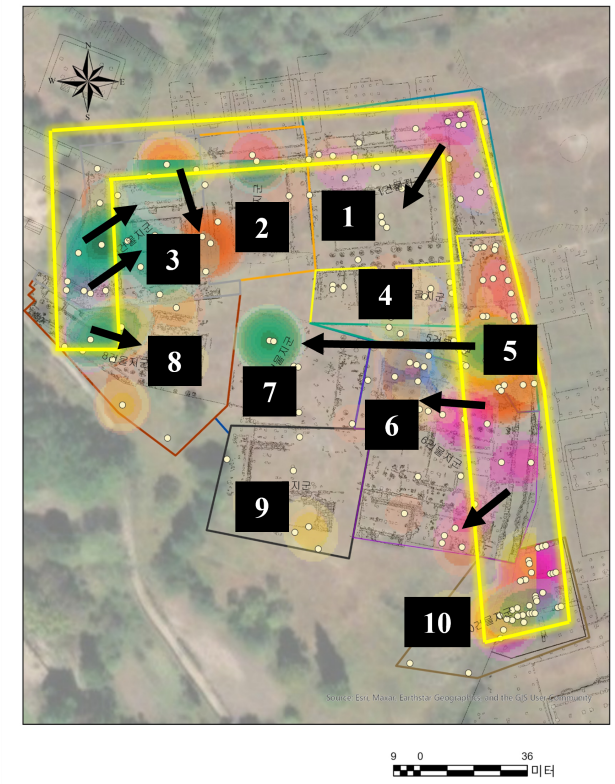

Figure 11. Density Concentration and Paths of Circulation in the Outer Areas, as Determined by the Production Periods of Excavated Celadon

4. Result and Discussion

In this study, the character of each building site group was analysed by utilizing the 28 attributes of Goryeo celadon built into the *ArcGIS Artifact Spatial Information Map*. In particular, the reconstruction of spatiality was conducted focusing on Building Site Groups 6, 7, 8, and 10, where distinctive characteristics in the ware type, quality, and patterns of the excavated celadon were identified.
In the analysis process, spatial characteristics were examined by cross-querying multiple attributes and through Kernel Density Estimation. Furthermore, to clearly visualize the overlapping distribution patterns, different colors were used, which were matched with the map's legend and the border colors of related figures to aid comprehension.

4.1 Analysing the Function of Building Site Group 6 through Excavated Celadon

Building Site Group 6 occupies the largest area within the Western Architectural Complex, and it also yielded the highest quantity of excavated Goryeo celadon, with 212 sherds (19.2%). Of particular note is building ruin 6-11, a long, corridor-style structure measuring 51.9m in length and 6m in width. A concentrated distribution pattern was observed here, with 37 of the 62 total dot-engraved celadon sherds from the entire site (60.0%) being confirmed at this location. All of the celadon with dot-engraved inscriptions are estimated to have been produced between the late 10th and the first half of the 11th century (Kwihan Kim, 2024). This suggests that the upper features of Building Site Group 6—namely, Building Ruins No. 6-1, 6-11 were connected to the Central Architectural Complex and Building Site Group 5 from the early Goryeo period, making them a core space within the Western Architectural Complex that was operational from the earliest period. The nine pieces of dot-engraved celadon identified in Building Site Group 5 are an important example of the spatial context of deposition (Yunjeong Kim, 2024). In particular, the fact that five of these pieces were concentrated in Drainage Channel No. 5-2, located below the northern foundation stones of Building Ruin No. 6-11, clearly demonstrates the importance of spatial information for organically interpreting the archaeological situation across different but adjacent building site groups (Table 2), (Figure 12).

Building Ruins No. 6-11 and Adjacent Ruins	Celadons with Dot-engraved Inscriptions		Total Quantity of Celadon
	Inscription	Quantity	
Building Ruins No. 6-11	*Gongsang* (供上), *Gong* (供), *Sang* (尙), *Juk* (竹), *Jungsang* (中尙), *Sin* (新), *Hyeon* (玄)	36	45
Drainage Ruins No. 6-5 = Interior on the Eastrrn stylobate stones of 6-11	*Sinsang* (新上), *Gongsang* (供上)	2	17
Yard No. 6-2 = Southern yard of 6-11 = Building Ruins No. 6-1	*Hyeonsang* (玄尙), *Gong* (供), *Gongsang* (供上)	3	9
Large Staircase No. 5-1	*Jeong* (井), *Sang* (尙)	2	53
Drainage Ruins No. 5-2 = Interior on the northern stylobate stones of 6-11	*Sang* (尙), *Juk* (竹), Unknown	5	31
Yard No. 5-3 = Eastern yard of 6-11	*Sinsang* (新上)	1	5

Table 2. List of celadons with dot-engraved inscriptions from Building Ruin No. 6-11 and adjacent site.

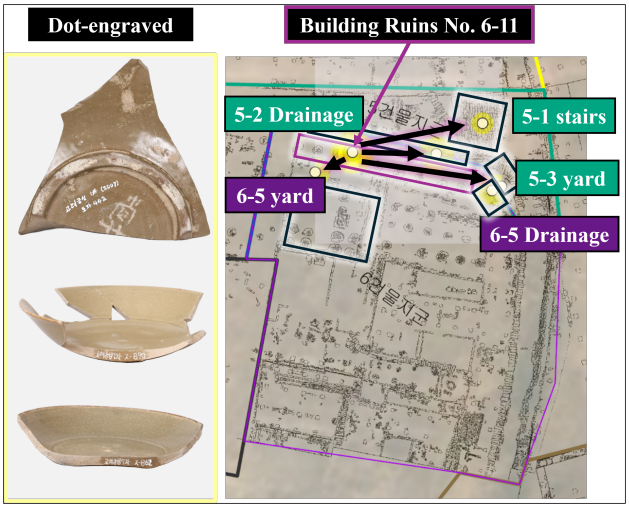

Figure 12. Building Ruin No. 6-11 and Adjacent Ruins where Celadons with Dot-engraved Inscriptions were Excavated

Furthermore, it is noteworthy for analysing the character of the building ruin that among the 60 Goryeo celadon sherds excavated from site 6-11, plate sherds account for 35 pieces (58.3%). Among the 39 dot-engraved celadon sherds from site 6-11, 23 pieces (58.9%) were also confirmed to be plates of an identical form. In addition, various types of plates produced

after the 12th century, such as flower-shaped, foliated-rim, and circular plates, were identified. When considered alongside pictorial sources from the period, this suggests the possibility that the site was a large-scale banquet space. In particular, since building ruin 6-1, the main hall of Building Site Group 6, is presumed to be the *Jangnyeongjeon Hall* according to the 1123 record *Xuanhe Fengshi Gaoli Tujing(宣和奉使高丽图经)*, it is highly probable that large-scale banquets or receptions were held at building ruin 6-11, located directly adjacent to it (Yunjeong Kim, 2024).

Spatial analysis using GIS can further expand this interpretation. When the scope of analysis was expanded to include Building Site Groups 1, 4, and 5—which are connected to building ruin 6-11 via a northern corridor—it was found that the same type of dot-engraved celadon was also excavated from these areas.

This result reveals an overlapping period of use corresponding to the 10th century in the early Goryeo period. This discovery demonstrates a spatial connectivity between the artifacts that is difficult to grasp from individual artifact data alone. In other words, the significance of the *ArcGIS Artifact Spatial Information Map* lies in its ability to provide a new analytical framework that enables complex spatial interpretation by linking adjacent archaeological features that share similar artifact excavation contexts (Figure 13).

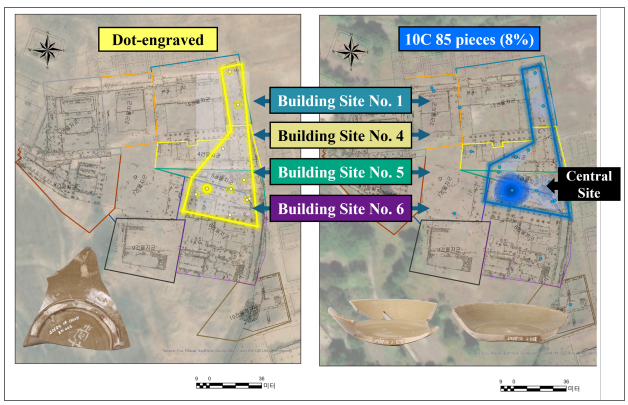

Figure 13. The Connected Distribution of 10th-Century Ruins where Celadons with Dot-engraved Inscriptions were Excavated

4.2 The Status of Building Site Group 7 as Determined by Excavated Celadon

Building Site Group 7 is a noteworthy space, as a large quantity of the highest-quality 12th-century celadon sherds from the entire Western Architectural Complex were excavated here. Aside from special ware types, the quality of celadon is typically distinguished by firing methods and patterns. Regarding firing supports, however, out of 772 identifiable cases, high-quality types like silica supports (295 sherds, 38.2%) and fireclay supports (175 sherds, 22.2%) were abundant. Given the high proportion of fine wares characteristic of the palace site, it was difficult to confirm a meaningful concentration via Kernel Density based on this criterion alone. In contrast, the analysis of patterns revealed that celadon with high-status dragon and phoenix motifs was concentrated in Building Site Group 7. Furthermore, Goryeo celadon imitating the style of Ru ware, an imperial ceramic of the Northern Song, was also densely distributed here, showing a clear distinction from other building site groups (Jiyoung Park, 2020).

Of all the dragon-patterned celadon found in the Western Architectural Complex, 5 out of 12 sherds were excavated from Building Site Group 7. Similarly, 5 out of 9 sherds with phoenix patterns were found here, accounting for the highest proportion for both types. The discovery of several Ru-ware-style Goryeo celadon sherds, a type mentioned in the 1123 record *Xuanhe Fengshi Gaoli Tujing*, also indicates the high status of this space (Lee Hee-gwan, 2015). Synthesizing these aspects of the 12th-century excavated celadon, it is evident that Building Site Group 7 was the most authoritative space within the Western Architectural Complex where the finest quality ceramics were used. Based on the concentrated excavation of highest-grade celadon not found in other building site groups, the existing theory that identifies Group 7 as the *Mallyeongjeon Hall*, the king's royal bedchamber, gains considerable validity (Changkeun Nam, 2020).

However, as Building Site Group 7 is in a state of severe damage, further discussion is necessary. This functional estimation will require more in-depth debate through additional spatial analysis using GIS data in the future (Figure 14).

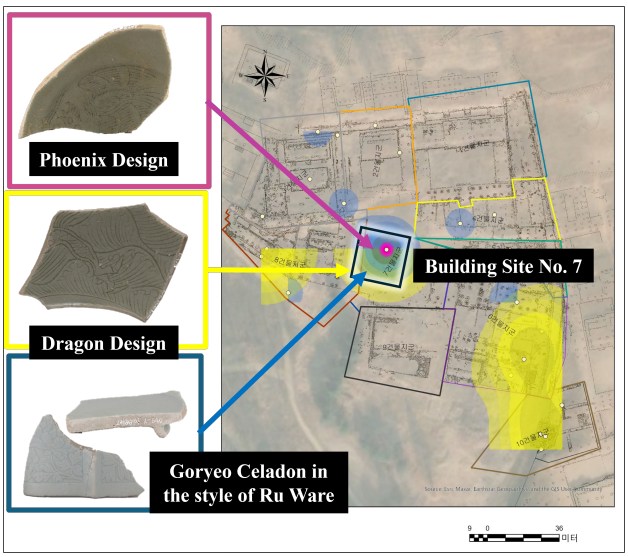

Figure 14. Building Site Group 7: Concentration of Celadon with Phoenix Patterns, Dragon Patterns, and Ru-ware Styles

4.3 Functions of Building Site Groups 8 and 10 as Determined by Excavated Celadon

Analysis of the *ArcGIS Artifact Spatial Information Map* reveals a unique excavation pattern in Building Site Groups 8 and 10 not identified elsewhere within the Goryeo Palace site. Specifically, this is the excavation of numerous celadon sets composed of identical patterns, as well as large quantities of celadon cup and cup-stand (*jantak*) sets. These celadon sets with identical patterns are broadly classified into three main groups: those with carved lotus petal patterns, molded peony patterns, and chrysanthemum scroll patterns.

The carved lotus petal pattern celadon set, produced in the 12th century, consists of a total of 39 pieces across 4 ware types, composed of 22 bowls (*bal*), 12 cylindrical cups (*tonghyeongjan*), 3 plates, and 2 lids. The GIS Kernel Density analysis shows that this set was excavated from overlapping areas in both Building Site Groups 8 and 10, indicating that the two spaces used the same set composition (Figure 15).

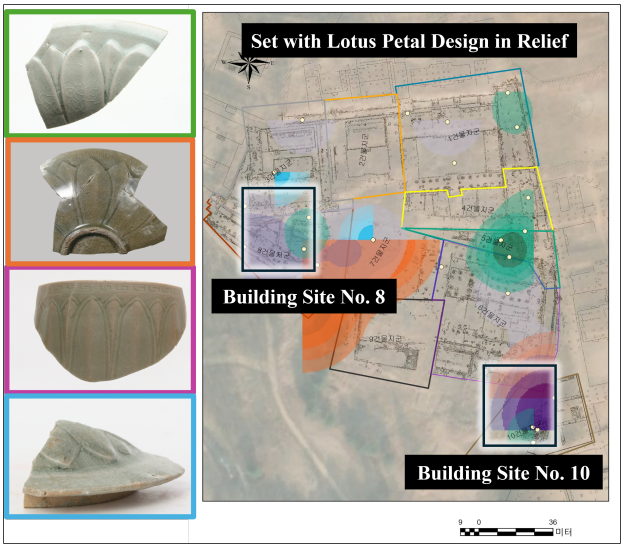

Figure 15. Concentration of 12th-century carved lotus petal pattern celadon sets in Building Site Groups 8 and 10

The 12th-century celadon sets with molded peony patterns are classified into two types according to their pattern composition. The 'peony scroll pattern' set consists of 19 pieces, and the 'peony spray pattern' set consists of 22 pieces; both sets comprise 3 ware types, including bowls, plates, and small bowls (*wan*). Both sets were found concentrated in Building Site Group 8 (Figure 16).

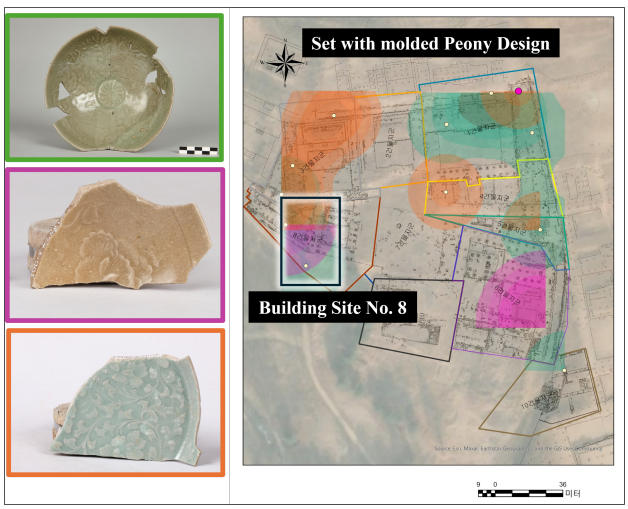

Figure 16. Concentration of 12th-century molded peony pattern celadon sets in Building Site Group 8

Finally, the 12th-century celadon set, featuring a molded relief chrysanthemum scroll pattern, is composed of 15 pieces in total across three types of wares: bowls, small bowls, and plates. This celadon with a molded relief chrysanthemum scroll pattern is concentrated in the eastern building site groups, which were used in a relatively early period within the Western Architectural Complex. The set's composition was found to be particularly concentrated in Building Site Group 10 (Figure 17).

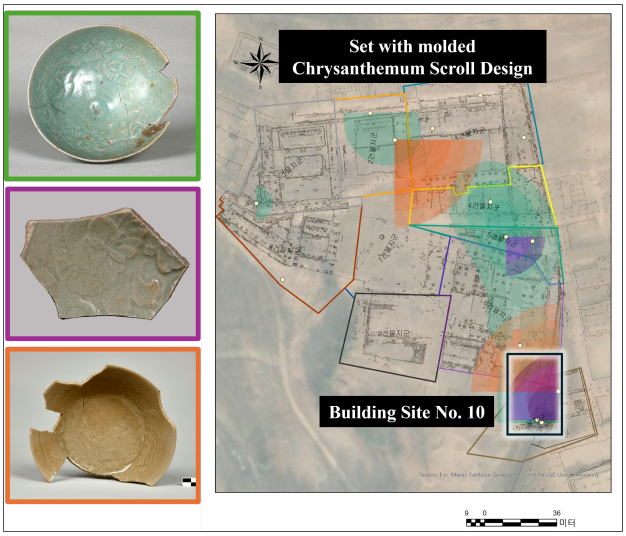

Figure 17. Concentration of 12th-century molded chrysanthemum scroll pattern celadon sets in Building Site Group 10

In addition to the previously examined celadon sets, celadon cup-stands were also excavated in large quantities from Building Site Groups 8 and 10, showing a high density on the Kernel Density map. This concentrated distribution allows us to infer the function of each building site group through its locational characteristics. Specifically, Building Site Group 8 is adjacent to Building Site Group 3, which is presumed to be the *Gyeongnyeongjeon Hall* associated with royal ancestral rites, while Building Site Group 10 is close to the *Hoeigyeongjeon Hall*, the main throne hall of the Goryeo Palace (Changkeun Nam, 2020).
Based on this, one can posit the possibility that Building Site Groups 8 and 10 functioned either as places where high-quality celadon sets were used for ritual ceremonies and official events, or as facilities for their storage and management (Figure 18).

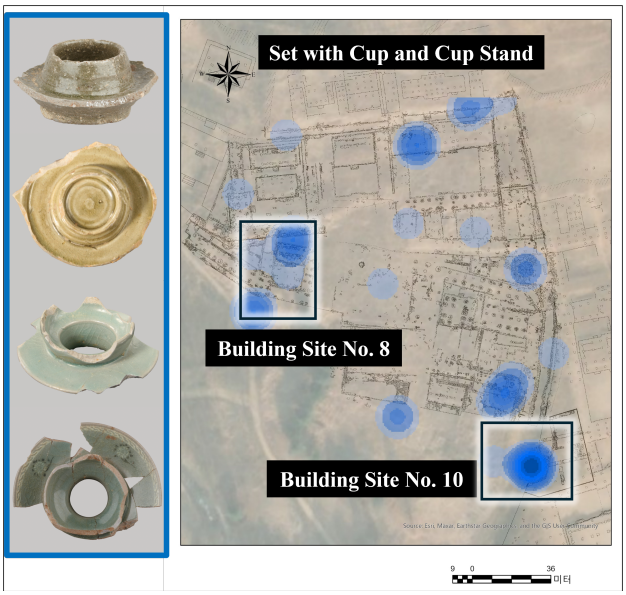

Figure 18. Concentration of celadon cup and cup-stand sets in Building Site Groups 8 and 10

5. Conclusion

This study presents a novel research method by applying GIS technology to the Goryeo celadon data from the Gaeseong Manwoldae site, integrating and analyzing individual artifact information and the site's spatial information within a single database. Through this approach, it can be assessed that this study has opened new horizons by elucidating the organic relationship between artifacts and space relationships difficult to grasp through conventional textual sources or individual artifact analysis alone—and by interpreting historical changes in the space through the distribution patterns of excavated artifacts.

The main findings derived from the GIS spatial analysis of this study are as follows. First, it visually demonstrated the historical shift in the usage area of the Western Architectural Complex, which was clearly divided into eastern and western sections with the Goryeo-Mongol War as a turning point. Second, based on attributes such as the ware type, quality, and patterns of the excavated celadon, it was possible to reconstruct the character of each space in a multi-faceted way. This includes postulating that Building Site Group 6 was a banquet space, Group 7 was a space of the highest royal hierarchy, and Groups 8 and 10 were spaces for the use of celadon sets.

The GIS spatial database construction methodology presented in this study has great potential for future scalability. This methodology, which utilizes general-purpose tools like Excel and ArcGIS, will provide an effective framework for interdisciplinary research, enabling scholars in adjacent fields such as medieval ceramic history, general history, and architectural history to verify various issues with visual data and share their findings. Furthermore, as its utility has been demonstrated in the case of Gaeseong Manwoldae, linking the excavated artifacts and spatial information from other Goryeo royal sites—such as the Ganghwa Palace, the Namgyeong site in Seoul, and the Hyeeumwonji *site* in Paju—to this study's database could be expected to yield meaningful results in the comparative analysis and reconstruction of the spatiality of royal Goryeo celadon.

Thus, the greatest significance of this study lies in its empirical demonstration of the utility and potential of a new research methodology that combines and interprets artifact and spatial information, moving beyond a simple case study of a specific site. However, this study has a clear limitation in that its interpretations are confined to the excavation data that has been made public to date. Therefore, the validity of the various functional estimations presented here remains a task for the future, requiring continuous supplementation through comparison and verification with archaeological and textual materials that will be accumulated over time.

Acknowledgements

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