# 7 Methodology

## 7.1 Excavation and documentation

### 7.1.1 Initial soil removal

Machine removal of upper levels of soil and modern overburden was necessary. An excavating machine from the contractors, with a toothless bucket, was used to facilitate this. The machine was supervised by Field Leaders or other appointed persons during this process, in accordance with the project methodology (similarly, the machine was sometimes used to remove larger archaeological layers and deposits, particularly within the moat, but also under strict archaeological supervision) (Fig. 17). It was anticipated that no contexts or deposits of archaeological interest would be uncovered in the top 1 m below present ground level, however during the initial Guide Wall machining of phase 5A-1, it was already apparent that in some areas this was not the case, with archaeology being encountered as little as 0.5 m below present ground level. In general, archaeology was encountered between c. 0.5 m and 1.0 m below the modern street surface.


Fig. 17. Machining and metal detecting. Removing larger deposits in the 17th century moat. Photo: Museum of Copenhagen.

### 7.1.2 Excavation procedures

Machine removal of upper levels was used to reduce modern soil without primary archaeological contexts and also to reduce archaeological deposits down to the top surface of the first in situ features. This enabled sometimes over 1 m of soil to be efficiently removed by machine. Different machines each with a toothless ditching bucket were monitored by archaeologists during this process. Although features were visible just under the topsoil they were not surveyed until the machining had been completed, therefore the top level (z-value) of the contexts relates to the level of the context when first visible. The archaeological contexts and finds were then cleaned, troweled, surveyed and identified before being recorded or excavated. All contexts received a unique identification number, generated by the total station.

A range of timber and stone and brick structures were also encountered, and once these were documented, it was sometimes necessary to use machinery or power tools to help in their removal, for example a chainsaw for large timbers; i.e. water pipes, bulwarks (also for sampling them), and power hammers or excavating machines to remove large stone and masonry structures; i.e. foundations Østerport, city wall, bridge, etc. Machines were also used to reduce the modern disturbances between the primary contexts thus improving the efficiency and reducing the heavy workload for the archaeologists.

All archaeological contexts were recorded according to the stratigraphical, single context method as described in Roskams (2001). Archaeological contexts were recorded and described down to the smallest visible event that could be identified by the archaeologist. These were then linked together to form a flow of events that happened through time on the site. Excavation was undertaken under stratigraphical methods, excavating primary contexts in reverse chronological order, starting with the latest (or youngest) feature first, working down to the earliest (or oldest) and undisturbed natural ground. According to the single context methodology, this is considered the easiest and most efficient way to interpret and recapture the activities that have taken place on a site, which is the overall aim of any archaeological investigation. It should be stated that in practice it was found that in features such as the moat, contexts that were very similar but separated by thin lenses of sand for example, were generally taken as being one context, but with the context description including details of how the lensing appeared. This was in part necessary due to the sheer scale of the moat; it was felt that the amount of individual contexts that would have been documented if this approach was not employed would have been so great as to be counter-productive, making a meaningful interpretation of the sequence all but impossible.

Excavation was primarily done by hand tools, shovel and mattock followed by trowel and occasionally brushes and leaf trowels for smaller more delicate excavation (Fig. 18). Each context was excavated in order and context sheets filled in on site. Six different types of context sheet were designed for the site; sheets for describing cuts, deposits, timbers, stones, modern truncations and trenches.

Contexts and features were photographed, sometimes with geomarkers from a vertical view. All contexts were surveyed, finds collected and samples taken where this was scientifically relevant.

Fig. 18. Excavating and documenting a barrel in trench phase 1S. Photo: Museum of Copenhagen.

### 7.1.3 Night work

Night work was completed in Bredgade (ZT7627) and in Holmens Kanal (ZT52627) on two occasions, from May $10^{th}$ - $11^{th}$ and May $19^{th}$ -$20^{th}$ 2010.The excavation work was carried out under constant supervision of archaeologists from Museum of Copenhagen with limited light conditions, where features of special archaeological interest were documented through measuring, section drawings and photography (Fig. 19).

Fig. 19. Documentation of former Lille Gjethus (cannon foundry) in present Holmens Kanal. Photo: Museum of Copenhagen.

## 7.2 Documentation principles

The overall methodologies that were used for the Metro project are stated in the project design (Thomasson & Høst Madsen 2009). These specify the use of museum standards for project management and museum policies on archaeological recording and finds handling (ibid). There are also strategy documents which describe the principles of finds management (Finds handbook 2010) and report management (Report management 2010) together with manuals covering how to use context sheets (Thomasson 2011). A feature typology was developed (Feature typology 2010). These were working documents however, and were changed and improved as deemed appropriate or necessary. The methodologies were also adjusted as relevant to follow guidelines produced by KUAS.

The archaeological features and finds were first being trowelled and identified before being recorded and excavated. All archaeological features (cuts, deposits, stone and timber structures) were recorded in writing on designated standard forms in the field, and the feature was measured with a total station. Every feature and in situ find got a unique identification number, generated by the total station. All information was then transferred and registered into IntraSiS Explorer and the feature put into an overall site matrix.

The form for recording of archaeological features was divided into three parts:

• The first entails overall information and primary identification such as data about position in the field, date of documentation and signature of excavator, as well as the identity of the feature, what kind of feature it was (cut, ditch, pit, posthole, etc.), its dimensions and type and its nearest stratigraphical relations (younger and older).

• The second part contained a description of the feature which concentrated on the details of the types of cuts located or details of soils present, etc. It was descriptive, and mostly multiple choice.

• The third part of the form holds the archaeologist's interpretation of the feature – what kind of cut or deposit was it and what can we further suggest about it? In this part all the gathered information put down in the first two sections should be seen as grounds for the interpretation. All ended up in a basic interpretation expressed in a feature type. These were pre-defined in IntraSiS and described in a strategy document (Feature Typology 2010).

The contexts were divided into three main categories according to their stratigraphic properties: layer/deposit, cut or structure. Different data were assigned to, and were documented about the different categories. For layers and deposits, recording was done on colour and substance of the soil; the degree of organic contents was noted as well as the compactness and how easily the context could be identified from its surroundings. This information when put together helps us to interpret how the context has come to be. Was the soil deposited in one event or over several deposition periods; in which case, why? What kind of activity did it result from? Or, did the soil build up gradually over a longer period of time? What activities could explain that? What did the contents suggest about the nature of the activity? These questions related directly to the stated themes and specific questions within the project objectives.

Information about finds, images and samples was also put on the form, as well as a sketch of the feature if necessary.

The matrix is a tool used for further grouping of the features and in the work of creating land use phases for the site. This consisted of assigning identities to groups of features, which can then be used to record the spatial and social use of the site. Land use phases of the area have been identified, depending on available information assessed alongside the older written material, which could identify which parts of the site were used during which historical periods and assist in answering some of the themes and specific questions concerning the development of the city throughout its use.

The photographic documentation has been thorough, and includes photogrammetry; where the geometric properties of objects are determined from photographic images of features and structures using fixed points surveyed by the total station. The recording process and results have been quality controlled on a regular basis by the Field Leaders and Excavation Leader. All this work was done within the time frame of the fieldwork.

In addition to the excavation of man-made deposits, some assessment of any exposed "naturally deposited" levels has been necessary, especially in cases where these are organically preserved and laid down within archaeological timescales; for example alluvial deposits. Some cut features, such as moats and wells were excavated to a greater depth than anticipated in the construction works, provided this was consistent with site safety, in order to adequately date and record such features of interest.

The standard terms for recording are stated in the Field Manual (2010) and are available in the IntraSiS software; these were conformed to during the excavation to ensure compatibility of the data throughout the excavation and project. Particular attention was paid by the Field Leaders and Excavation Leader to the quality of recording and understanding of the stratigraphic sequence by the archaeologists.

### 7.2.1 Documentation procedures

The context sheets were completed and the features were measured by the excavating archaeologist. This person also recorded the data into IntraSiS. The attribute data was then checked by the responsible Field Leader and the person responsible for compiling the matrix and stratigraphy. The geometric data was imported in IntraSiS by the person responsible for the total station and IntraSiS, who also checked the quality of the measurements.

Procedure: *Archaeologist* ➔ *measure and record context; Archaeologist* ➔ *attribute data IntraSiS; Matrix/stratigraphy person* ➔ *check attribute data; total station/IntraSiS person* ➔ *geodata IntraSiS*.

Basic contextual grouping (subgroups and groups) were initiated by the excavating archaeologist, but decided by the Field Leader and the person responsible for compiling the matrix and stratigraphy. The attribute data was recorded in IntraSiS by the Field Leader or the matrix/stratigraphy person. Templates (recording parameters as well as descriptive narratives) for recording subgroups and groups were meant to be developed during the course of the excavation, but because of time pressure on site this job was done after the fieldwork phase. These were discussed at milestone meetings and groups were part of the report structure.

Procedure: *Archaeologist* ➔ *suggests subgroups and groups; Field Leader* ➔ *defines subgroups and groups; Field Leader or matrix/stratigraphy person* ➔ *IntraSiS.*

Other contextual groupings were done after the fieldwork phase and recorded in the IntraSiS database.

## 7.3 Digital resources and computing support

### 7.3.1 Operating systems

All computers were run on Microsoft Windows XP SP3. The applications were hosted on Microsoft Windows server 2005 terminal servers and accessed via the internet through a secure SSL/VPN tunnel. The databases were hosted on Microsoft SQL server 2005, also accessed via the terminal servers.

### 7.3.2 Office applications

Microsoft Office 2008 suite was used across the network and hosted on terminal servers. Microsoft SharePoint Services were used to share documents and spread information across the different sites and departments.

### 7.3.3 Survey

For surveying, Trimble S6 total stations with handheld control units were used. The coordination system used is called DKTM zone 3 and the height system used is called DVR 90. The excavation conditions were sometimes very complicated. The site was divided into several areas and some of these areas were very small and narrow. Therefore measuring with the total station was difficult and even impossible in some cases. Therefore the measuring sometimes had to be supplemented with manual hand drawings.

All geometry was collected within the DKTM coordinate system. The geometrical objects were then imported into the database.

### 7.3.4 Database

The IntraSiS Explorer system created by the Swedish National Heritage Board was used for the collecting, relating, structuring and archiving of data. IntraSiS is a geographical information system designed specifically for dealing with archaeological information and data. The archaeological database structure has been developed specifically for archaeological data captured using the single context recording system on the specific site. In IntraSiS analysis you are able to do different types of analyses on the collected information. For example, you can do different types of dispersion maps, tables and plans.

The program consists of two separate parts, Explorer and Analysis. IntraSiS Explorer is a database where all collected data are stored. In Explorer you also register all relevant archaeological information and create relations between different objects. The system utilizes SQL server 2005 which was hosted on the terminal server.

### 7.3.5 GIS analysis

ESRI ARCGIS 9.3 was used for all deeper GIS analysis and for working with digital maps, geo-referencing and transforming. All archaeological GIS analysis was done with the IntraSiS Analysis software.

### 7.3.6 Project management

Microsoft SharePoint Services was used as a project document sharing software.

### 7.3.7 File output and data exchange formats

All database files were exported to MS Access standard file formats. Text descriptions were exported as .rtf files and read in standard word processing programs. The geometry was exported as personal geo-databases in .mdb format, or in any of the standard file formats such as .dxf, .shp, .dwg.

### 7.3.8 Security

Backups of the entire system were done on weekly, monthly and yearly cycles, while an incremental backup was run each night. All backup media was stored off site at the terminal server hosting company. Monthly emergency recovery checks were done to control the recreation of selected data i.e. SQL databases. Logon to the systems was done via SSL/VPN software and by token. The Symantec Endpoint Protection antivirus software was used to prevent malicious code entering the systems, along with firewall solutions provided by the terminal server hosting company.

### 7.3.9 Site-specific support

The computing support for the project involved the provision of input and validation mechanisms for site attribute data, digitizing programs for the planned information and word processing/desktop publishing for the production of reports.

### 7.3.10 Bonn seriation & statistics

The ArchEd module of the Bonn Archaeological Statistics package allows strings of stratigraphic relationships to be loaded and interactively checked. Inconsistent or contradictory relationships were identified and removed and a validated Harris Matrix diagram produced as graphical output. All stratigraphic relations were exported from IntraSiS in a .lst file format to be imported directly into ArcEd.

The stratigraphic relationships of checked site records were loaded by individual site supervisors as excavation progresses.

## 7.4 Excavation manual

The field manual was designed as a guide to the compilation of the archaeological site record for the Kongens Nytorv excavation (Alexander et al. 2010). This consisted of written, photographed and surveyed contexts using a single context recording system (where a “context” is a simple unit of record and is usually defined stratigraphically).

The manual followed the best practice from other guidance and manuals for single context recording, primarily the MoLA site manual (Westman 1994), combined with best practice for IntraSiS documentation, where the database has been specifically designed for this project. It covered the instructions for completing the three types of field recording sheets and for surveying contexts using a total station, and combined it with the guidance for data entry into the IntraSiS database.

The single context recording system creates a very large number of separate records. Creating relationships between these records is the main way of understanding the site sequence. For this purpose the Kongens Nytorv excavation used the Harris Matrix. This provides a simple method of relating one context to another according to their relative stratigraphic positions.

The relationship of any one context to any other was established during excavation. Each context was planned using the total station once it was fully exposed, and a relevant context sheet was filled out recording its stratigraphic relationships. These relationships could be checked for accuracy in IntraSiS and a “site matrix” compiled.

If it was necessary to record the stratigraphy in section rather than plan, the section/elevation was drawn on drawing paper with a typical scale of 1:10, 1:20 or 1:50, and incorporated into the IntraSiS database manually. A section drawing had its own matrix diagram drawn and was cross-referenced with any known identical contexts in surrounding areas.

Procedures for the retrieval and processing of finds, the taking of environmental samples and photography are also described.

## 7.5 Stratigraphic division and phasing

Archaeological excavation is a complex, collective social practice, irreducible to the individual. It demands a standardisation of practices and systemisation of recording. Most importantly, the stages in the production of archaeological knowledge require detailed consideration and application. The processes of reassembling the archaeological data after excavation and of reconstructing the site's various structures, types of activity and chronological development, are complicated and arduous (McLees et al. 1994:10-12).

The theory and method of stratigraphic excavation and post-excavation analysis have been dealt with in many previous archaeological texts (see Harris 1979; Harris et al. 1993). Essentially, stratigraphic excavation can be perceived as the conceptual basis for the structuring of observations and perceptions of material culture. It is the means by which we attain practical engagement with the material past. The method centres upon the conceptual and physical deconstruction of the site into discrete units, namely the stratigraphic unit or "context". It provides a means of focusing upon the physical properties and the chronological and spatial relationships of the different components within an archaeological site. Consequently, stratigraphic excavation facilitates the recording of three fundamental dimensions of contextual knowledge from the bottom up. Through manipulating and analysing these various contextual relationships it then becomes possible to reconstruct the site interpretively in terms of activity, phases of occupation and periods of development.

The adoption of the theory and method of stratigraphic excavation requires the learning and practice of specific techniques which are employed on a collective basis. These define the relationship between forms of excavation and types of on-site recording, and structure the movement from site deconstruction to site reconstruction in the written report. The differing practices employed in the use of stratigraphic excavation are not arbitrarily related; on the contrary they are intricately linked. They need to be logically and systematically followed through if the necessary knowledge is to be produced by which archaeology can enter and further develop the general debates on urbanization.

In stratigraphic excavation the archaeologist follows the actual formation process of a particular site as closely as possible (although in reverse chronological order). The formation process consists of a relative sequence of events which constitutes the history and development of a site. These are identified and recorded as a sequence of stratigraphic contexts. By "context" is meant an individual archaeological unit of stratification which represents a specific processual event in a sequence. Thus, a context may consist of a backfill, a dump of construction material, a structural element for a building, a pit or material filling a trench. Consequently the remains of a building, for example, can consist of a number of stratigraphically associated contexts – individual flooring elements, walling elements, etc. The stratigraphic method places equal value on each context and the relationships between them, both in terms of the process of excavation and methods of recording (Harris 1979:73).

A stratigraphic sequence of contexts is presented graphically in the form of a matrix (or Harris Matrix). This comprises the "archaeological reality", Harris's "testing pattern", which represents in a two-dimensional form the unique chronological sequence of site formation processes. The stratigraphic matrix is consequently the key tool for the integrative process of site reconstruction, providing as it does the means by which the spatial and descriptive data can be systematically organized. By progressively integrating contexts in stratigraphically and functionally defined groups the basic processual units in the reconstruction process are formed. They are then in turn amalgamated into higher level groupings, closely spatially and temporally correlated, and with greater interpretative significance. It is through the identification of these interpretational units that complex patterns and sequences of cultural-historical activity emerge. By working from the level of the individual context through to higher order interpretative groupings of contexts, an array of qualitatively differentiated processes and activities is defined.

Manipulation of the primary data, therefore, begins with the subdivision, or sorting, of the “raw” matrix into distinct groups of contexts. By virtue of their close stratigraphic relationships and complementary physical characteristics, these groups of contexts, can be said to derive from the same formative process and type of activity.

### 7.5.1 Harris Matrix

In keeping with the principles of single context recording and the excavation methodology of the Museum of Copenhagen, a Harris Matrix was created concurrent with the ongoing excavation to facilitate understanding of the stratigraphic relationships between contexts across the site. This was done without reference to artefactual dating, dendrochronology or other analyses, which were later amalgamated into the results during post-excavation work.

The subgrouping and grouping were undertaken on site as far as possible alongside the creation of the matrix, both for expediency and to allow the first hand knowledge of the archaeologists to be incorporated into these processes. The Harris Matrix for Kongens Nytorv was created using the program Stratify to maintain consistency across the Metro excavations (along with Rådhuspladsen and Gammel Strand) where this program was also used.

The matrix, subgrouping and grouping were collated through the program Stratify, which was available as a free download. This program works by compiling a database of known stratigraphic and sub-group/group relations from which it then composes a visual depiction of a Harris Matrix. This diagram is static and cannot be manipulated by the user to account for e.g. contexts on the same chronological level, and once a context is within a group its stratigraphic relations are no longer illustrated – only those of the group. This necessitates the careful cross-checking of all stratigraphic relationships across a large number of contexts so as to mitigate later errors in grouping and phasing.

The Harris Matrix was created by transferring the immediate stratigraphic relations of each context as recorded by the archaeologist on the context sheets into the database of the Stratify program. These relationships were checked with those of other relevant contexts, geo-objects and stratigraphic relations in the IntraSiS database, and relationships already entered in the Stratify program, so that all cross-referencing was accurate. During the first field seasons one person had overall responsibility to create the matrix and group contexts to minimise potential errors and maintain consistency across the excavation, from 2012 this work was divided between Field Leader(s) and the overall responsible archaeologist (Rachel Morgan). It was expected that this post-excavation work would be completed to group level during the field time, but this could not be implemented due to time pressure on site.

Matrices for each subarea were created separately due to the scheduling of excavations, to avoid compound errors and due to the integral capacity limits of the Stratify program used.

### 7.5.2 Biographical stages

On every object, there was a statement relating to the biography, either labelled as construction, usage or deconstruction. The purpose of this exercise was to create conditions to understand duration, change and usage of the objects. It also clarifies the source value of the finds material and the scientific analysis conducted. When the biographical stage is established it is easier to understand what is dated, for example, when sending in a $^{14}$C-sample for analysis. It also provides tools to understand how the finds material is deposited. If this is a primary deposition, then the scattering of the finds have a source value in relation to how the object was used. If it is re-deposited, then it is less likely that the scattering of finds have a source value relating to usage.

The logic of stating biographical stages is that it relates to an object on the nearest level above the registered context or object. A fill in a posthole relates for example to the deconstruction of a wall, rather than to the posthole as a cut. A new floor layer relates, according to the same grammar, to usage of a house.

Accordingly, biographical stages can never be stated on group objects. These are the outcomes of the recorded activities on context and subgroup levels. Group objects contain, rather than being part of, biographies.

One can divide the understanding of the cultural layers and stratigraphy in three directions:

• Construction

• Usage

• Deconstruction

After processing the archaeological material:

• Reconstruction

Construction means the activities organized/created surface of feature. Usage means the traces of activities in progress and deconstruction involves the phase where usage has been discontinued or changed. The reorganization involves converting the archaeological monument to the source material in the form of drawings, writing and more.

### 7.5.3 Relative chronology and physical stratigraphic relationships

A single layer can be affected by and superimpose several cuts and several layers and structures. The layer in turn can superimpose other contexts. There is a difference between physical relationships and a stratigraphic relationship (relative chronology). On this archaeological investigation, the relative chronology has been used.

### 7.5.4 Terminology

The basic ontological idea of the recording system at the Museum of Copenhagen was to deconstruct in order to reconstruct. Contextual documentation is a system of recording, sorting and interpreting archaeological remains. It consists of single context recording and the following different grouping levels.

Single-context recording clarifies, organizes and arranges chronologically. The archaeological method is based on documenting and removing the contexts in the reverse order of how they accumulated; the archaeological sequence deconstructed down to the smallest identifiable event that left its mark. These are called stratigraphic units or contexts. Each layer, filling, cut, etc. will have its own ID, and thus becomes its own context. These have a separate description and interpretation. To arrange chronologically with a stratigraphic approach is thus a form of contextual understanding. A stratigraphic unit is the end product that has been created through various documentary processes at different times.

Stratigraphic units influence each other in a network of relationships. A relational schema is a sequence of time represented by the relative stratigraphic relationships of the different contexts. No event occurs as an isolated phenomenon, but part of the series and context. On Kongens Nytorv there was a complex stratigraphic situation because the site had lengthy continuity. The Harris Matrix is used to organize and visualize this. The material is processed through clustering or dividing into phase or time. These steps build on each other and are processed in this order.

The routine in this archaeological excavation meant that each context had its own ID when it was measured with the total station. The data of the context was entered on the context sheet. Upon registration in IntraSiS a relationship was created between the object studied and stratigraphic relationships.

Contextual grouping is an interpretive method to relate recorded activities that are parts of the same object and/or reoccurring use. It consists of creating and structuring relations and attribute data according to defined principles. It was a part of the museum's aim to integrate tasks usually separated in fieldwork and post-excavation stages, enabling both real time quality checks and contextual reflections. The aim of grouping was to take the interpretation of a context through a recognisable chain of interpretational stages that structures the data. The grouping is also of importance for the prioritisation of samples that were sent for analysis.

The report concerns the principles and procedures of taking site data from context to group level, and was read in conjunction with the excavation manuals. The document contains definitions of context, subgroup and group types that were used in the registration in IntraSiS. The process of grouping and subgrouping contexts was to a certain extent done continuously during the fieldwork phase.

The typologies were working documents, open to additions of new types and improvements. There are five concepts describing the different interpretive levels; contexts, subgroups, groups, land use and phase. Each level contains objects. The biography of each object is referred to as three stages, involving construction, usage and deconstruction.

It was decided that the interpretative hierarchy on site would consist of five levels:

### 7.5.5 Context level

The context is the base element of the single context recording system that is used at the Museum of Copenhagen (cf. Thomasson 2011). These are to be understood as single activities that have resulted in detectable remains. There are four types of contexts, where the recording parameters are designed to assure a consistent and quality assessed documentation of material. These are deposits, cuts, stone/brick structures and wood structures.

The context typology relates to these as single objects, and provides them with a basic cultural historical interpretation which is a key element in the creation of the grouping process.

Note that there is an inconsistency in how different context types are documented. While sill stones for example are provided with a single identification number directly when recorded by using the total station, postholes are provided with separate identification. Postholes usually have no direct physical contact, and are therefore regarded as separate activities (even if digging a hole for a post could be regarded as the same type of activity as laying down a sill stone, or for that sake, placing a brick in a wall). To be consistent however, spatially separate rows of sill stones must be provided with different identity numbers. At the other end of the scale, a close-knitted row of sill stones covering all four walls of a house, was recorded with a single identity number. Note also that there has to be a stratigraphic analysis like sill stone rows as well. Primary and secondary parts have to be regarded as separate contexts.

The contexts are parts of the biography of a subgroup or group object. A biography has three stages, construction, usage or deconstruction, which relates to the nearest object on the interpretive level above the context. The contexts create the biographical narratives of subgroup and group objects.

Imprints after wagons (wheel ruts) or footprints were recorded as usage, in relation to subgroup and group objects, such as roads, yards, etc. Imprints from constructions were recorded according to the same principles as postholes.

If the contexts in question relate to subgroups labelled as deconstruction, then these also were recorded as belonging to the deconstruction stage on context level. This was the case when the subgrouped contexts represent the demolition of more than one subgroup object or a group object.

The terminology is directed to describe the function of the context (not the subgroup or group). The intention with the context typology is to provide a concluding interpretation to be recorded on the context sheets. Thereby it's possible to get a consequent terminology, at the same time as the documentation material is based upon equal (for as possible) interpretive levels. The different alternatives were presented on a pick-list in IntraSiS, which limits spelling mistakes.

The typology was defined on the basis of a functional (more or less) interpretation of common (medieval/historical) archaeological contexts; i.e. the question to ask was why the context was created – for what purpose, and not be labelled after content or other attribute data.

The interpretation was based on the documented parameters stated on the context sheet (empirical recording/interpretation) and contextual observations. A cut with sloping sides can for example be interpreted as a posthole if it was spatially situated within a row of cuts. The function of a deposit can also be determined through its position in a stratigraphic sequence. If a layer of sandy gravel was situated directly underneath a pavement, then it was likely that it had been deposited to work as a foundation layer to support the cobbles.

Additionally important was that the terminology was on the same interpretive level, corresponding to each other and to the hierarchy of contextual groupings. Thereby, the terminology could be used as a tool when searching and analysing the IntraSiS-databases, as well as making it easier to present the findings in our reports.

The following was an attempt to create a typology suitable for excavations in Copenhagen. Attributes, for example material and content of a deposit, were not mentioned in the labelling of the typology, but stated in the description and registration parameters, and easily extracted from IntraSiS such as Floor Level (type) and Clay (material).

Any further interpretations, on higher levels, were done as part of the contextual groupings.

This was the most basic unit of recording in the field.

- Carried out by archaeologists on site this involved recording on context sheets and with the total station.

### 7.5.6 Subgroup level

Subgroup objects are sorting tools, providing a number of necessary levels to describe the group objects. The number of subgroup levels relates to the complexity of the group object and/or preservation conditions. Contexts don't have to be subgrouped, and can be directly related to the group object.

Subgroups are objects containing contexts and/or other subgroup objects that are joined together. These represent either parts of fragmented contexts, or constructive units that in turn are parts of group objects.

Fragmented and separate parts of what is understood as the same context is the most basic level of subgroup objects. The subgrouping has in this case the function to connect the different parts of what once was the same entity. The labelling of the subgroup object is then a repetition of the stated context type.

This case could for example be illustrated by a fragmented floor level, which is preserved in several different spatial units. By subgrouping these, it is stated that these belonged to the same object. Next level of subgrouping is to relate this subgroup to other subgroups or contexts, for example foundation layers, to create the subgroup Floor.

A second example is when the preservation conditions are good. Parts of the foundation layer (i.e. primary fill) and a post are preserved in a posthole. The purpose of the subgrouping is to state that these contexts belong together and were labelled Post. Next level subgrouping then relates with other subgroup objects and contexts that belonged to the same wall.

Group objects that represent complex constructions are likely to create more subgroup levels. The path from context to group object is longer.

Remains of houses can for example have many subgroup levels. If it has been equipped with a basement, the basement is a subgroup object. This can in turn consist of several subgroup objects such as a floor, a wall and a cut.

The registration of stages of subgroups relates to the nearest object on the interpretive level above. It could therefore both relate to other subgroup and group objects. The subgroup object that was recorded was part of the biography of a greater entity.

Subgroup objects that were parts of the initial construction of the group object were stated as belonging to the construction stage. A subgroup object that represents a secondary addition to a group object, such as a new inner wall, was a part of the usage stage. There can be many usage stages related to one group object.

Remains that relate to the deconstruction of a subgroup object (but not the group object) were stated as parts of the deconstruction of a subgroup object on a lower subgroup or context level. This could for example have been the case when an inner wall was demolished (i.e. the subgroup object), and not the house (i.e. the group object), then the fills of the postholes (contexts) were stated as deconstruction (and related to the subgroup object Inner wall).

Remains that relate to the deconstruction of the group object were related to a separate subgroup labelled as deconstruction, because the activities relate to the group object. Consequently, these subgroup objects could also be recorded as being part of the deconstruction stage (relating to the demolition of the group object).

Remains that relate to the deconstruction of more than one subgroup, but not the demolition of the group object, were subgrouped and labelled as deconstruction. But the subgroup was however part of the usage of the group object, in the sense that it was a part of a change (renovation of the house) of it, and ought therefore to be stated as usage.

The only attribute recording that was done was the labelling of the type of subgroup. More elaborate information about the subgroup object was given on group level. Notes ought to be stated in the IntraSiS free text field of the subgroup object. Biographical stages were recorded in a pick list as well.

Due to the flexible character of subgroup types, it was not possible to create a pick list of possibilities and use this in IntraSiS. It was the responsibility of the registrar to follow the given instructions.

The terminology used when creating subgroup types was as much as possible related to the intended function of the object (contrary to the parts which were recorded as contexts). There were two forms of subgroup objects:

The first was subgroup objects that consisted of contexts that had been fragmented into two or more spatial entities. In this case the type labelling was a repetition of the context type. In cases where a subgroup object for example consisted of a posthole, foundation layer and remains of a post, then the object was labelled Post as it was the most decisive term describing the function.

The second was subgroup objects that were constructive parts of group objects. Basements or walls were for example parts of buildings, which in turn could contain other subgroup objects.

Attributes or characteristics were avoided in the labelling terminology, creating a clear and comparable terminology and promoting interpretation (contrary to description). A wall was labelled as a wall. If it had been constructed in brick or made of posts with wattle and daub that was stated at group level. The terminology was to strive after the most depicting and interpretive term.

Certain types of subgroups could never constitute group objects. Among these were for example floors and basements, which always have to have been parts of a house. In the same way, a posthole and a fill were never regarded as a subgroup. In general, it was a constructive part of larger construction, such as a wall or a fence, and the contexts were related to these objects. In the rare cases, when it could be established that it was the intended outcome, then the posthole, together with the fills and other remains constituted a group object that was labelled Post.

This was a means of reducing the numbers of contexts into more manageable small groups. These subgroups consisted of a set of contexts related to one activity, for example a construction cut, the wall in it and the construction backfill. Another example of a subgroup could be the three contexts that make up a posthole; the cut, the post itself and the backfilled earth around the wood.

- These subgroups were suggested by the archaeologist excavating the feature, the associated contexts box on the context sheet allowed for this, and then verified by the Field leaders once they had been entered into IntraSiS by the archaeologist with special responsibility for IntraSiS.

### 7.5.7 Group level

A group is the intended physical outcome of the (materialised) activities recorded at context level. Groups relate to objects or structures. There are however limits, which relate to the scale of archaeological excavations. A fortification, with moat, walls, buildings, etc., can for example be understood as the intended physical outcome if it was planned and the works were conducted as part of one enterprise. The intention of the group definition is however adjusted to cover smaller entities that are suitable for the archaeological scale; everything from a moat and a building to a quarry pit. Group objects cover in any case a wide range of types, from very simple to very complex objects.

Contexts and subgroups are parts of group objects. The number of subgroup levels is dependant upon preservation and the complexity of the group object. To identify group objects is the final part and aim of the contextual grouping during the field phase.

Group objects contain biographical stages, defined at subgroup and context levels. Group objects are per definition parts of the usage stage of the excavated site, and there is then no point to state biographical stages at group level. Changes above group level are changes in usage, and are therefore parts of interpretations on land use and phase levels done during post-excavation.

The templates in IntraSiS contain registration parameters facilitated with pick lists. These covered both attributes on group and subgroup levels, as well as relating to the Method Statement.

The free text field in IntraSiS was used as a narrative description, which also could be used as report text. The group level in IntraSiS was regarded as the interface between database and report.

Certain group templates are already parts of the default setting of the IntraSiS projects. If additions or completely new group templates are needed, then a draft was presented to the archaeology management meetings and created by the IT coordinator.

The terminology used when labelling group object types was as much as possible related to the intended function of the object as an entity (contrary to the parts). Attributes or characteristics were avoided in the labelling terminology, creating a clear and comparable terminology and promoting interpretation (contrary to description). Attributes were recorded as parameters in IntraSiS. The list of group types was not settled and new types could be added continuously.

Group types are however prioritised and vital parts of the quality assessment of the documentation material. New types generate work to create templates in IntraSiS, which enables elaborated possibilities to create active, functional and searchable data. The decision to define group types was an issue, as earlier stated, for the archaeology management meeting.

In turn subgroups were clustered together with other subgroups by virtue of their stratigraphic relationship to form a group. A subgroup post could cluster with other subgroup postholes to form a fence or bulwark which in turn could be clustered with a timber structure such as revetment to produce a "phase". These groups also denote whole structures within the site, for example a building, road or pit series (if they are all contemporary). These were compiled when the subgroups, for example in the case of a building, the walls, floors and occupation layers, were associated and given a number.

- Again the archaeologists were able to make group suggestions, but the decision for grouping was taken by the Field Leader overseeing a particular area. These too were entered into IntraSiS by the archaeologist with special responsibility for IntraSiS.

### 7.5.8 Land use phasing

Phase implies a near contemporaneous archaeological horizon representing "what you would see if you went back to a specific point in time". Often but not always a phase implies the identification of an occupation surface that existed at some earlier time. The production of phase interpretations is one of the first goals of stratigraphic interpretation and excavation and the process of interpretation in practice will have a bearing on excavation strategies on site, so "phasing" a site is actively pursued during excavation where at all possible.

- This stage of analysis was completed after fieldwork was concluded and therefore carried out by the Excavation Leader or Field Leader responsible for writing the report. This stage was carried out once the groups had been checked and verified.

### 7.5.10 Land use

This is the overview of how a landscape changed over time. This is the level at which the report will be written where a narrative can be constructed to tell the story of the site that has been under investigation throughout history.

- This part was done entirely by the report authors as part of the publication process.

### 7.5.11 Watching brief and excavation

Documentation varied because of the nature of the investigation. The major areas on and around Kongens Nytorv used the contextual approach. During watching briefs the procedure was somewhat easier and only in exceptional cases, it was possible to dig single-context (with the exception of the Station Box). Rather it was common practice to document sections and use the total station to survey plans or draw them from the trench limits. The preparation of descriptions and photography became if anything more important as the archaeological remains were sometimes not able to be documented in any other way.

## 7.6 Finds procedures

### 7.6.1 Introduction

The retrieval and registration of finds was subject to methodologies described in the finds handbook (Finds Handbook 2010).

A strict methodology was created to standardise the process of finds retrieval, processing, recording and report writing for the Metro Cityring excavations. Finds retrieval and storage would follow methodologies derived from ‘First Aid for Finds’ (Watkinson & Neal 1998) and assistance and education from the National Museum of Denmark. Set out in this chapter will be methodologies that follow the finds procedure set out in Guidelines for Finds (Københavns Museum 2010).

### 7.6.2 Classification

#### *7.6.2.1 Special finds and bulk finds*
Before excavation commenced it was determined which finds were bulk finds or special finds. This was undertaken with a view to retrieval methodology, recording methodology, surveying and storage methodology. With regular site meetings some special finds were downgraded to bulk finds due to amount. This happened especially when excavating the moats when large quantities of finds were retrieved (Tab. 3).

#### *7.6.2.2 Special finds*
Finds classified for extra analysis which would provide extra information for sites. They are usually personal items, dress accessories, or coins and supply a rich insight into the past. For this reason, they require special care in terms of handling and conservation.

#### *7.6.6.3 Bulk finds*
Generally, large quantities of finds, in comparison to smaller assemblages of special finds. Examples can be seen below. Prioritization may occur on certain types of bulk finds.

| **Special Finds** | **Bulk Finds** |
|---|---|
| Metal artefacts (copper alloy, iron, lead, gold, silver, pewter, tin, etc.). | Iron nails, copper alloy pins, large structural pieces of building material |
| Medieval and earlier glass, decorated Post medieval glass | Post medieval glass (window and bottle), undecorated |
| Amber, ivory artefacts | Undecorated stone building material. Sampling to occur after recording on context sheets |
| Decorated animal bone (un-decorated animal bones are registered as part of natural sciences) | Slag and kiln furniture |
| Decorated clay tobacco pipes | Clay tobacco pipes |
| Textiles | Worked flint |
| Leather items | Leather waste cuts, unidentified fragments |
| Decorated ceramic building material (floor-, stove hearth- and wall tiles) | Non-decorated ceramic building material |
| Decorated wooden artefacts | Daub and fired clay |
| Ceramic (figurines, lamps, graffiti, stamps, moulds, complete pots). | Pottery |
| Decorated stone material. i.e. statues, moulded fragments | |
| Decorated shell artefacts. Shells used as finds | |

Tab. 3. The division of special finds and bulk finds.

### 7.6.3 Retrieval and on-site and finds recording procedures
The retrieval of finds was subject to methodology described in the finds handbook and according to decisions made during the excavation.

The retrieval of finds was subject to the methodology described in the finds handbook (Museum of Copenhagen, 2010). Archaeological finds retrieved during the excavation were added into IntraSiS as Finds Units. Special finds were measured in by total station, whereby Finds Unit identities are generated in the IntraSiS database. Finds Units for bulk finds were created by the archaeologists. The excavating archaeologist would split the finds material collected from the same context/excavation unit into various material types, and place it in a bag, labelled with KBM number, context number and Finds Unit ID number if already created on site. The date and finder’s initials were noted, as well as trench number. KBM Collections department staff were consulted and used in the lifting procedure of selected delicate artefacts.

Regular contact and meetings between the Excavation Leader, Field Leaders, on site finds assistant and Finds Coordinator occurred. With this contact, issues such as prioritization of finds, retrieval methodology and on site conservation could be discussed and problems could be easily solved, and if necessary, methodology. Regular contact also occurred with the Museums' conservator and the Conservation Department of the National Museum of Denmark so that standards were high, and so that delicate objects and structures could be excavated and removed in the best possible condition.

It was decided that no artefact fragments less than 5mm long would be collected unless deemed of special importance. Due to the large quantity of nails from the moat fills it was decided, as the excavation progressed, that they would be counted, registered and weighed and then discarded.

Each bag was registered in IntraSiS as a Finds Unit (see instructions below). Each bag and a manilla tag were marked with the following information:

- KBM-number
- Context number
- Finds Unit ID
- Initials of excavating archaeologist
- Date

On the bag, the KBM-number was written on the top left hand side. The context number should be written in the centre of the bag, along with the Finds Unit ID. Below, the initials of the excavator and date should be written.

The manilla tag stating the same information as recorded on the finds bag was then placed in the bag along with the finds.

### 7.6.4 Finds processing

The finds were then transported to the museum, processed (cleaned, weighed, counted, placed in bags and marked) then converted within IntraSiS from Finds Units into Finds Objects, whilst the fieldwork was on-going. Finds were processed and stored in their appropriate preservation styles according to methodologies adopted from First Aid for finds (Watkinson & Neal 1998) and from guidance from the conservation department from the National Museum of Denmark.

### 7.6.5 Registration within the IntraSiS program

Within the documentation process, artefacts were registered in the Finds Object section of IntraSiS. In this way they were further sorted using appropriate typologies, dated and split into function type. Through this process, information regarding chronology, trade, wealth, and land use was discerned. This information was then obtained by the archaeologists whilst the excavation was on-going.

### 7.6.6 Basic registration

The entering of information into the following fields in the "Class" section of the IntraSiS finds registration interface: Material, Type (including subclass information in obvious cases), Date range, Weight, Number and Degree of fragmentation.

### 7.6.7 Finds subclasses

The subclasses were generally classified by function using function types that are similar to categories seen in the NORM registration and Museum of London registration systems. The artefacts that could not be identified were placed in an unidentified section. Bulk finds were continued as separate subclasses due to specialism, as is usual (Tab. 4).

| **Finds subclass** | **Examples of types of finds** |
|---|---|
| Medieval pottery (c. 1060-1535 AD) | Pottery dating from medieval periods from c. 1050–1535 AD |
| Post medieval pottery (c. 1536-1800 AD) | Pottery dating from the Renaissance period (c. 1536–1660 AD) and later Post medieval period (c. 1661–1800 AD) |
| Stove tiles | Decorated and undecorated tiles from stoves |
| Leather shoes and clothes | Various types of clothes (non military), shoes, slippers |
| Textile | From clothing to household furnishings i.e. covers, curtains, etc. |
| Glass | All types of glass vessels and window glass |
| Slag and other metallurgical waste | All by-products of metalworking |
| Wall tiles | Decorated and undecorated tiles from structures |
| Household equipment | A selection containing wooden house furnishings to metal storage items, barrels, buckets and cooking and non ceramic storage objects |
| Arms and armour | Military weapons, projectiles and armour |
| Coins and tokens | Coins and various trading tokens |
| Personal finds | A broad category representing finds linked to the individual, i.e. jewellery, badges, brooches, religious, buttons, etc. |
| Combs and comb cases | Combs and comb cases from all periods from all different materials |
| Toys and games | An assemblage of all types of toys, games, gaming boards and gaming piece fragments |
| Horse equipment | All types of equipment for the horse, i.e. horse shoes, -nails, etc. |
| Tools | All various craft tools and equipment linked to industry |
| Ships and fishing equipment | Finds covering the broad spectrum of maritime archaeology and fishing equipment |
| Security equipment | Archaeological equipment comprising various types of keys, locks and draw bars |
| Textile production tools | Crafts persons' equipment linked to textile production and repair, i.e. pins, needles, thimbles, needle cases, etc. |
| Trading equipment and cloth seals and other seals | Cloth seals, trading stamps, various trading objects outside of glass and ceramic finds objects |
| Writing equipment | Slates, pens, stylus, stylus cases, wax slates |
| Statues and figurines | Various statues and decorated fragments of stone |
| Knives and cutlery | Domestic knives and knife and handle fragments, table knives, spoons and forks |
| Flint | Flint tools, gun flint and percussion flint |
| Clay pipe | Clay pipe fragments, pipe production equipment and figurines |
| Rope | Rope fragments |
| Building materials | Roof-, floor-, ridge tiles, bricks and other building related materials. Decorated and undecorated |
| Non grouped/subclassed objects | Various finds, either unidentifiable or corroded through soil conditions |
| Nails | Nails from many periods and types of manufacture |

Tab. 4. Finds subclasses and examples of types of finds.

### 7.6.8 Finds recording procedures

Archaeological finds retrieved during the excavation was added into IntraSiS as Finds Units. Special finds were measured in by total station, whereby Finds Unit identities were generated in the IntraSiS database. Finds Units for bulk finds were created by the archaeologist responsible for finds. The archaeologist responsible for finds split the finds material collected in the same context/excavation unit into various material types, and placed these with a tag in a bag, labelled with KBM number, context number and Finds Unit ID number. KBM Collections department staff were consulted and used in the lifting procedure of selected artefacts.

Procedure: *Special finds* → *Archaeologist measure* → *Finds Units; Bulk finds* → *Archaeologist retrieve by hand* → *selection material/bag/context* → *Archaeologist with special responsibility* → *Finds Units*

The finds were then transported to the museum, processed (cleaned, weighed, counted, placed in bags and marked) then transformed within IntraSiS from Finds Units into Finds Objects.

Procedure: *Finds Coordinator* → *Finds Objects* → *Registration*

Within the documentation process, artefacts were registered in the Finds Object section of IntraSiS. In this way they were further sorted using appropriate typologies, dated and split into function type. Through this process, information regarding chronology, trade, wealth, and land use could be discerned. This information was then obtained by the field archaeologists and Field Leader during excavation and post-excavation work.

Appropriate specialists could further document the various material types after the excavation was completed. The finds material was described, analysed, assessed and incorporated as chapters/sub-chapters in the site report (see Appendices 13-41), and then the finds were returned to the museum. After the reporting and registration of artefacts was completed, the finds were archived, some photographed and then added to the permanent collections. A new ceramic reference collection has been created with the finds for use by members of the public, students and specialists (T:\Collections department finds\Reference collection (constantly being updated)). Although not all artefacts have been retained, the information they yielded has been stored on the museum database.

Procedure: *Finds coordinator* → *registered finds to specialists; specialist analysis and report* → *to Finds Coordinator; Finds Coordinator* → *draft to Excavation Leader*

### 7.6.9 X-ray

Selected iron artefacts that were in a high state of corrosion and thus difficult to document were X-rayed, concentrating on those that were selected for their preservation and ability to enhance the archaeological research themes. Most copper alloy and silver objects were X-rayed too. Approved artefacts were photographed during excavation.

These methods of documentation allowed an accurate record of the items that augmented the written finds registrations and can be archived for future research. The Finds Coordinator and the Excavation Leader/Field Leader selected which finds to be sent for X-ray. The formal decision was taken by the Collection Department Leader (responsible for the conservation budget). The consultant (Bevaringsafdelningen in Brede, National Museum of Denmark) together with the Finds Coordinator identified the objects and the Finds Coordinator recorded the final identification in the IntraSiS database.

Procedure: *Finds Coordinator and Excavation Leader* → *choose finds for X-raying; Finds Coordinator* → *finds to be X-rayed; Finds Coordinator* → *record data in IntraSiS*

### 7.6.10 Conservation procedures

Conservation of finds was undertaken in various ways, either by on-site conservation or by continuous conservation.

#### *7.6.10.1 On-site conservation*

If an artefact of importance was uncovered, the Field Leader or Excavation Leader contacted the Finds Coordinator, who then visited the excavation and assessed the situation. If possible, the find was lifted either by the Finds Coordinator or by the archaeologists with the advice of the Finds Coordinator. If the find was of great importance, after consultation with the Excavation Leader, the Finds Coordinator contacted the Collections Leader, who in turn liaised with the National Museum of Denmark, conservation department to visit the site and retrieve the artefact. The artefact/find was then transferred to Brede to be cleaned and stabilized. After the find was stabilized it was sent back to the museum for analysis.

Procedure: *Archaeologist* ➔ *informs Field Leader of fragile important find; Excavation Leader* ➔ *contacts Finds Coordinator; Finds Coordinator* ➔ *lifts the artefact/contacts consultant:*

#### *7.6.10.2 Conservation in general*

Throughout the excavation, there was regular contact between the Excavation Leader and Finds Coordinator to identify finds for conservation. Meetings were undertaken between the Metro Project Leader, Excavation Leader, Collections Leader and the Finds Coordinator concerning these finds, and the methodology to be used on these finds. The Collections Leader then liaised with the National Museum of Denmark to collect the artefacts, and a budget was organized. The consultant, when necessary, recorded additional information in IntraSiS and, in liaison with the Collections Leader, sent back the finds for storage at the museum.

Procedure: *Finds Coordinator/Collections Leader* ➔ *contacts Consultant; Consultant* ➔ *collect finds; Consultant* ➔ *record information into IntraSiS; Consultant* ➔ *Finds sent back to museum*

### 7.6.11 Liaisons

Meetings were organized between designated KBM specialists, external specialists, the Metro Project Leader, Excavation Leader and Field Leaders during the course of the excavation (see Chapter 2.2 for the project team structure for the site). These were in the form of quality assessment meetings or contact via telephone and e-mails. The purpose of these contacts was to discuss excavation progress, finds processing progress and whether excavation style and strategy needed to change. There were also quality assurance meetings at regular intervals in the schedule to ensure the quality of the fieldwork and documentation.

### 7.6.12 Report writing

The specialists added further documentation on the subclasses. The material was described, analysed, assessed and incorporated as chapters/sub-chapters in the site report (see Appendices 13-41). The finds were then archived, photographed and added to the permanent collections.

## 7.7 Sampling and analytical procedures

Samples for environmental and scientific analysis were collected from structures and layers on site and occasionally from artefacts and other materials during post-excavation. This was done in order to enhance knowledge of the archaeology unearthed and for better interpretation. An outline of the overall methodological framework of how and why sampling for scientific analysis was undertaken will be given here.

With adherence to the Danish Museums Law, in which no research may be undertaken within the scope of contractor financed archaeology, the majority of scientific sampling involved processing and evaluating the empirical results. Combined with this was the retention of a high quality source material for future research. All sample related work was agreed on by the museum together with KUAS on an ongoing basis during the excavation.

Samples were extracted by archaeologists or (very occasionally) consultants on site and further sampling was undertaken in the laboratories by consultants. Many of the bulk soil samples were initially processed within the museum, by museum employees, with John Howorth being responsible for this work. The samples were ultimately examined in external laboratories by consultants within Public Procurement, and sub-sampled as necessary.

Through the tender selection process the Museum of Copenhagen assured collaboration with highly qualified consultants. The consultants handled the analyses, and were available to provide assistance during fieldwork. They partook in the planning and development of sampling strategies during the archaeological excavation, to varying degrees depending on their specialism.

### 7.7.1 Procedures and organization

Sampling was conducted according to the principles laid out in the Method Statement (2010). The archaeologist with special responsibility for samples insured that the labeling on samples taken during fieldwork corresponded to the information in the IntraSiS database, as well as for transportation of samples from site to the museum, and finally to oversee and coordinate the work with connection to samples according to the principles laid out in the Method Statement.

The Excavation Leader delegated responsibility for which samples were sent for analysis to the Field Leaders. The formal decision was taken by the museum Science Coordinator in cooperation with the specialist and the Field Leaders, who later informed the Excavation Leader. Each analysis and proposal was followed by a written justification, which was related to how the results could contribute to the excavation aims (what do we want to know and why). The procedures were established according to agreements with KUAS (Minutes of Meeting between KBM and KUAS 4th of September 2009) and their guidelines (KUAS Vejledning 2010).

The Field Leaders and museum Science Coordinator were responsible for contacting consultants, writing requisitions, defining timeframes as well as the scope of the analyses, to oversee that the results were recorded in IntraSiS and that reports were done according to the given instructions (Appendix 1 in the Public Procurement). An important task was also to provide the consultant with the written justification. The museum Science Coordinator was also in charge of sieving and flotation of the macro samples and transportation of samples from the museum to the consultants.

The consultants were responsible for entering the results of the analysis directly into the Museum of Copenhagen's IntraSiS database. Templates for this purpose had been developed cooperation between the consultants and the Museum. Each template had been developed in accordance with the various standards of the field of expertise in question. The consultants were, furthermore, responsible for producing reports for each set of analysis. These reports contained a description of the methodology, empirical results and basic interpretations as stated in Appendix 1 in the Public Procurement. All procedures were stated in the six agreements within the procurement (Rammeavtal, bilag 1 2009). The sample analyses were handled according to the procedures set up for each scientific field.

The evaluation of the environmental procedures and results took place at quality assessment meetings, described in section 7.8. in the Method Statement (2010).

Procedure: *Archaeologist/consultant → samples; Excavation Leader and museum Science Coordinator → analysis; Consultant → record results in IntraSiS*

### 7.7.2 Recording of bulk, monolith and core sampling

All samples taken within the fieldwork phase were measured in by total station. Sample identities were then generated in the IntraSiS database. If the sample was analysed, it was the responsibility of the analyst to create a sample analysis ID in the IntraSiS database.

Procedure: *Archaeologist (measure) → sample ID; Consultant → Sample analysis ID*

### 7.7.3 Sample recording from finds

All finds were entered and registered in the IntraSiS database according to the principles laid out in section 5.5 in the Method Statement (2010) and in the Finds Handbook (2010). When a sample was to be taken from a find, it was the responsibility of the Finds Coordinator to create a sample ID in the IntraSiS database. If this sample was to be analysed, it was the responsibility of the consultant to create a sample analysis ID in the IntraSiS database.

*Procedure: Finds Coordinator → sample ID; Consultant → Sample analysis ID*

### 7.7.4 Recording of sub-samples

It was the responsibility of the consultant to create a sample ID in the IntraSiS database, i.e. when picking out organic material from macro samples for C14 analysis. The sample analysis ID was created by the consultant conducting the analysis.

Procedure: *Consultant* ➔ *Sample ID; Consultant* ➔ *Sample analysis ID*

### 7.7.5 Procedures for sending samples to analysis

Mechanical sampling was conducted regarding macro analysis (sampling motivation is to found in Method Statement (2010)). The responsible field archaeologists recorded the sample circumstances. The Field Leaders together with the Excavation Leader had responsibility to take the initiative to assess the sample/group of samples for the analysis potential. An analysis motivation was filled in by a Field Leader and sent to the Science Coordinator. This motivation was related to cultural historical questions relating to the Method Statement (2010). The Science Coordinator saw to it that the samples were assessed (cultural historical potential) by the consultant that was named on the analysis sheet. The Science Coordinator together with the Field Leader and Excavation Leader took the decision to send the sample for analysis.

Procedure: *Field archaeologist* ➔ *takes sample according to directives in this document, if macro describes sample circumstances; Field Leader* ➔ *cultural historical motivation for analysis; Excavation Leader* ➔ *Science Coordinator order analysis* ➔ *Consultant*

### 7.7.6 Sampling techniques

The sampling techniques were based on the aims of the excavation and thus they related to the types of remains recorded in the different area types (Tab. 5). Sampling methodologies in the different areas were in accordance with this, and corresponded to the specific methodology as described above. There was a great need for consistency concerning the different kinds of sampling, to avoid this being randomly conducted without thought for the aims of the excavation. On site the archaeologists responsible for overseeing the work concerning finds and samples were also responsible for the procedures and were in regular contact with the Finds Coordinator as well as the Science Coordinator. Sampling was carried out using a range of techniques and each technique procures samples for a variety of scientific testing as stated in the table below.

| Sampling techniques | Sampler | Type of analysis | Tool | Size | Packing |
|---|---|---|---|---|---|
| Bulk sampling | Archaeologists, Consultants | Macro, zoological, wood, C14, entomology | Trowel | 100% of the context or max 4 litres. | Plastic bags with a manila tag showing identification. Commonly used |
| Monolith sampling | Archaeologists, Consultants | Macro, pollen, zoological, wood, geological, entomology, micromor-phology | Trowel | Squares 15x15x15 cm | Wrapped in cling film with a manila tag showing top layers and identification |
| Core sampling | Archaeologists, Consultants | Pollen | Auger | - | Wrapped in cling film with a manila tag stating top layers and identification. Rarely used |
| Other field sampling | Archaeologists, Consultants | Dendro, wood | Trowel, axe, saw, etc. | - | Wrapped in plastic with a small amount of clean water – manila tag stating identification |
| Sampling from finds | Consultants | Zoological, metallurgical, chemical, geological, C14, dendro, wood, macro, pollen | Laborat ory | - | Packed to withstand transport as well as to meet the requirements of the material in question |
| Sub-sampling | Consultants | Macro, pollen, zoological, dendro, entomology, | Laborat ory | - | Packed to withstand transport as well as to |

| | | |
|---|---|---|
| | metallurgical, chemical, geological/ceramic, C14 | meet the requirements of the material in question |

Tab. 5. Sampling techniques.

### 7.7.7 Bulk sampling

Bulk samples were taken from a chosen context and contained only material from one context. 100% of a small context or a maximum of 4 litres from a larger context was considered to be a sufficient amount for bulk sampling from the rich urban layers represented in the excavations. Archaeologists or consultants on site were responsible for extracting the samples. The material was collected by trowel and kept in plastic bags with manila tags stating identification number and context. All samples were measured in by total station and registered on context sheets and in IntraSiS with cross references to the relevant sample numbers and contexts. The sample type was registered as a point in IntraSiS. As a context may differ in content from one area to another, even though it seems uniform to the naked eye, more than one sample from the same context had unique identities. On site the archaeologist with special responsibility oversaw the procedures and was in contact with the museum's Finds Coordinator and Science Coordinator.

Bulk samples were sieved at facilities in the finds basement at the Museum of Copenhagen by museum employees. The extracted material was assessed by an archaeobotanist working for RAÄ (Riksantikvarieämbetet, Sweden) and subsequently sent off to the relevant laboratories. Material for a variety of scientific disciplines was derived from bulk sampling. It was primarily a technique for procuring samples for macrofossil analysis, but the samples also produced material for C14-dating, wood anatomy, geological, entomological and chemical analysis. Material for zoological analysis – small skeletal parts like fish vertebrae and scales, small mammal and bird bones, etc. – was derived from bulk sampling. After discussion with the responsible specialist extra bulk samples of 5 litres were taken during fieldwork phase (2011) for these specific purposes from several contexts. Bulk sampling was done in connection with all excavation area types. The sampling type was closely related to single context registration and was relatively more frequent than monolith and core sampling, described below. Bulk sampling was conducted from vertical sections as well as horizontal surfaces.

### 7.7.8 Monolith sampling

Monoliths are samples taken from vertical sections/profiles, or if wished, from horizontal surfaces. The samples can be cut out of vertical sections or horizontal stratigraphy in 15x15x15 cm squares using a clean trowel – or using monolith tins which are available in two sizes. When the sample was taken as a cube it was wrapped tightly in plastic film immediately after extraction. All samples were marked with top/bottom and labelled with a manila tag stating identification number and context.

Archaeologists or consultants on site were responsible for extracting the samples. All samples were measured in by total station and registered on context sheets and in IntraSiS with cross references to the relevant sample numbers and context. The sample type was registered as a point in IntraSiS and each monolith had its own unique ID. On site the archaeologist with special responsibility oversaw the procedures and was in contact with the museum's Finds Coordinator and Science Coordinator.

Monolith samples were taken from a single context or could contain several layers or contexts. If the sample contained more than one identifiable context, it was clearly noted on the sample so it could be divided by the consultant in the museum according to the archaeological interpretations of the remains, coupled with observations made by the consultant. Separate sample units for each context were then to be created in IntraSiS by the consultant. This sample type was always processed by consultants and was not sieved by museum employees as was the case with the bulk samples. Analysis of monolith samples focuses on the vertical composition of the layer. However homogeneous a deposit might seem, it may have a very diverse composition from bottom to top, including evidence of its genesis which is lost if the material is bulk sampled, sieved and the residue sent off to the specialists. Analysis of monolith samples included plant macrofossils, zoological, entomological, micromorphological and geological material as well as material for C14-dating, chemical analysis and pollen analysis. This sample type was taken in connection with all area types related to the excavation, but was of course specific to vertical sections. Monolith samples from smaller sections of horizontal surfaces in order to gain knowledge of a structure's use through time, and the representation of activity/event areas across floors and streets were also taken.

### 7.7.9 Core sampling

Cores samples were extracted by auger. Immediately after extraction the sample was placed on a supporting plastic board and wrapped tightly in plastic film. All samples were marked with up and down arrows and with a manila tag stating identification number and context. Archaeologists or consultants on site were responsible for extracting the samples. All samples were measured in by total station and registered on context sheets and in IntraSiS with a unique ID and related to the relevant context. The sample type was registered as a point in IntraSiS and each core was given a unique sample ID. If new layers were to be documented within the course of the analysis, it was done by the archaeologist with special responsibility, based on the information from the consultant. On site the archaeologist with special responsibility oversaw the procedures and contacted the museum's Finds Coordinator and Science Coordinator.

Core samples are often used to determine the depth and extent of structures and layers – or to obtain undisturbed samples for a variety of analyses. Cores were taken from chosen locations or structures that may contain several layers or contexts. The sample type was always processed by consultants and was not sieved by museum employees as was the case with the bulk samples. Detailed vertical analysis of core samples can extract knowledge concerning the origin and the history of a layer through time. Analysis of material from core samples included that of plant macrofossils, zoological, entomological and geological material, while the core could also provide material for C14-dating, chemical analysis and pollen analysis.

### 7.7.10 Sampling from finds

Sampling from finds involved procuring material from Finds Objects for macrofossil analysis, C14-dating, geological, zoological, chemical, fungal and wood anatomy analysis, as well as a series of analyses which were not included in the tenders. These analyses were ongoing throughout the fieldwork phase as well as after. Finds were registered and stored at the Museum and were thus accessible for further analysis when needed. Analyses done in order to answer culture-historical questions were to be handled by the Science Coordinator as described in the Introduction to this chapter, while sampling done as a part of the conservation process was the responsibility of the Finds Coordinator. The sampling was done by consultants in the laboratory. The Collections Department consulted the Scientific Coordinator before forwarding the samples to the relevant consultants for further scientific analysis. When samples were derived from Finds Objects, either as part of the conservation process or as part of the effort to answer questions about age, composition, morphology, provenance, etc., the consultants created separate sample units for each sample in IntraSiS. All samples were registered in IntraSiS with relation to the relevant find ID and context.

### 7.7.11 Further sampling from samples (sub-sampling)

Further sampling from samples includes those collected from bulk, monolith, core or other field samples. The analyses of these were ongoing throughout the fieldwork phase as well as after. Analyses done in order to answer culture-historical questions were to be handled by the Science Coordinator, while sampling done as a part of the conservation process was the responsibility of the Finds Coordinator (Tab. 6 and 7). The sampling was done by consultants in the laboratory. The Collections Department consulted the Scientific Coordinator before forwarding the samples to the relevant consultants for further scientific analysis. When samples were derived from other samples, the consultants created separate sample units for each sample in IntraSiS. All samples were registered in IntraSiS with relation to the relevant find ID and context.

### 7.7.12 Types of analysis

| Contract holder | Type of analysis | Purpose |
|---|---|---|
| Nationalmuseets Bevaringsafdeling Brede. NBB | Metallurgical analysis | Determination of provenance and composition of material, technology, craftsmanship, etc. |
| Nationalmuseets Bevaringsafdeling Brede. NBB | Fungal analysis | Preservation/degree of decay of wood remains |
| Nationalmuseets Bevaringsafdeling Brede. NBB | Chemical analysis | Identification of a wide range of material, composites, human activity i.e. adhesives, colouring, tanning, animal husbandry, land use etc., as well as origins of amorphous organic remains not otherwise identified |
| Kvartärgeologiska avdelningen, Geologiska Institutionen. Lunds Universitet. KGI | C14-dating | Determination of age of deposited organic material |
| Statens Naturhistoriske Museum | Zoological analysis | Determination of species, sex, age, size, pathology etc. of deposited animal remains |
| Riksantikvarieämbetet. Arkeologiska uppdragsverksamheten. RAÄ | Plant macrofossil analysis | Determination of deposited plant remains |
| Riksantikvarieämbetet. Arkeologiska uppdragsverksamheten. RAÄ | Pollen analysis | Determination of deposited pollen |
| 1. Nationella Laboratoriet för ved-anatomi och dendrokronologi, Geo-logiska Institutionen, Lunds uni-versitet. NL<br>2. Dendro.dk | Dendrochronology | Determination of age of in situ wooden structures or deposited wood |
| Nationella Laboratoriet för vedana-tomi och dendrokronologi, Geolog-iska Institutionen, Lunds universitet. NL | Wood anatomy | Determination of species of deposited wood |
| 1. Ceramic Studies, Sweden. CS<br>2. Nationalmuseets Bevaringsafdel-ing Brede. NBB | Geological analysis | Provenance, age determination, type of geological material, assessment of geological features, site formation processes, etc. |

Tab. 6. Contract holders and types of analysis within the Public Procurement nr. 2009-070118: Conservation and natural sciences in the Metro project.

| Other prioritized types of analysis | | |
|---|---|---|
| Statens Naturhistorisk e Museum | Entomological analysis | Environmental conditions (i.e. wet, dry, saline, etc.) |
| Riksantikvarie ämbetet. RAÄ | Soil micromorpho-logical analysis | Detailed stratigraphic analysis (i.e. activity layers on floors and streets) |

Tab. 7. Types of analysis outside the Public Procurement.

### 7.7.13 Sampling – purpose, methods and strategies

Sampling strategies for the site within the field of natural science had to be, as far as practicable, consistent throughout the excavation. Standard issues within urban historical studies – related to the background, direction and characterization of urbanization; economic and demographic fluctuations and the cultural and social implications and consequences for city life – combined with previous knowledge of the site – were essential for the implementation of the sampling strategies. This directed how the strategies were carried out and which sampling strategies and methods were most appropriate for the different type areas.

### 7.7.14 Metallurgical analysis

***Purpose of analysis:*** Metallurgical analysis of objects and slag containing metals and corrosion products can provide detailed knowledge on composition, provenance, mechanical properties and processing history of archaeological metal objects.

Polished cross sections of metal samples are examined by optical and scanning electron microscopy in order to identify the alloy and describe the mechanical property of the sample.

Chemical analyses can add further information regarding the metal value and provenance.

***Sampling techniques:*** Samples for metallurgical analysis were predominantly collected from metal objects and slag. These were, as Finds Objects, collected according to the principles described earlier. Samples were however, also collected from environmental samples. In the latter instance they were collected as bulk samples or as a part of the macro analysis.

***Strategy for sampling and analyses:*** Metallurgical analysis on finds was predominantly done after the fieldwork phase. The decision to conduct analysis was taken on the basis of the object, its context and its culture-historical potential, and was carried out in order to complement the interpretations made from the analyse of other source materials.

The identification of the different types of material use and craft can lead to knowledge of how objects were made; i.e. craftsmanship, technological knowledge, the availability of craft material and also its provenance. The latter has helped to pinpoint the scale of local craftsmanship, and local material versus imports.

### 7.7.15 Chemical analysis

***Purpose of analysis:*** Chemical analysis can be used to identify the composition of a range of materials as well as traces of human activity otherwise unidentified – i.e. the use of adhesives and colouring, mortars and other building materials, practices of tanning, animal husbandry, land use latrines, etc.

Analytical techniques such as Fourier Transform Infra Red Spectroscopy (FTIR) and Common and Pyrolysis – gaschromatography with mass spectrometry ((PY)-GC-MS) can be implemented to identify the nature and origin of amorphous organic remains that cannot be identified through, for instance, optical microscopy. The methods are common in forensic and analytical chemistry and are often employed in cases of analyses of fossil fuels, hallucinogens, adhesives, paints, inks, etc., the Method Statement enabling identification of specific markers, thereby uniquely identifying components pointing to specific materials.

Scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM-EDS) is useful for characterizing both degraded inorganic and organic materials. The method is useful for identifying components in Finds Objects, i.e. composite textiles and corroded metal objects, as well as areas of manufacture on site.

Portable X-ray Fluorescence (PXRF) can identify remains of metal in the soil that might indicate metallurgical activities on the site, such as spilled molten metal or glazing as well as colouring substances; i.e. pigments of coloured plasters thus identifying areas of manufacture on site, for instance different kinds of smithies, as well as the provenance of colouring on Finds Objects.

The identification of these substances could lead to knowledge of how objects were made; i.e. craftsmanship, technological knowledge, the availability of craft materials and their provenance, which then again may pinpoint the scale of trade connections versus local manufacture of goods.

Chemical analysis on material from Kongens Nytorv was requested by the museum and carried out in relation to ceramics (ICP analysis) to establish their provenance, and in some cases analysis was carried out at the behest of specialists as appropriate for their work, for example in relation to conservation and metalwork analysis.

***Sampling techniques:*** Samples for chemical analysis were collected from Finds Objects as well as from bulk samples.

***Strategy for sampling and analyses:*** Samples for chemical analysis were collected from features of special interest which might give evidence of human activity like land use, craftsmanship (including any sort of finishing of materials for decorative as well as utilitarian purposes), industry, etc.

Chemical analysis of Finds Objects was predominantly carried out after the fieldwork phase, according to the principles described earlier. The decision to conduct the analysis was taken on the basis of the object, its context and its culture-historical potential, and carried out in order to complement the interpretations made from the analyse of other source materials.

### 7.7.16 C14 analysis

***Purpose of analysis:*** C14 analysis can establish the age of organic (carbon-based) remains from before the 17$^{th}$ century.

***Sampling techniques:*** Samples were collected from chosen contexts. Material for analysis was generally extracted from macrofossil samples or animal or human bone material, which was first identified by the relevant specialist.

***Strategy for sampling and analyses:*** C14 analysis was carried out when stratigraphy and finds material were insufficient to determine the age of a context or group of contexts vital for the understanding of the site. Samples were analysed according to their cultural-historical potential during and after the fieldwork phase. C14 analysis cannot be used on material dating from the middle of the 17$^{th}$ century onwards. C14 analysis on Finds Objects is carried out according to the principles described earlier. Dendrochronological analysis was prioritized over C14 analysis where it was an option to use it.

### 7.7.17 Zoological analysis

***Purpose of analysis:*** Zoological analysis is used for identifying animal species, age/size and pathology, as well as determining butchering practices, thereby providing information about food consumption, animal husbandry and land use.

***Sampling techniques:*** Animal bones were hand collected according to procedures described in the Finds Handling section. It was decided during the excavation however, that in the case of large deposits such as moat fills (which were often very rich in bone material) that hand retrieval of bone would have been too inconsistent and biased towards large bones, and instead it was decided that bone would be recovered from "big bag" bulk samples during post-excavation sieving, and from 2 litre bulk samples in the case of very small bones such as fish bones. Bone artefacts (such as toys or skates) were of course exceptions to this, and were retrieved during excavation if observed. In general deposits of relevance which contained small fragmented bones (fish, bird, mammal, etc.) were bulk sampled and later sieved (at least 50% of the volume, or 2 litres). The collection method was stated on separate context sheets, and documented during the bone retrieval process. Animal remains found during sieving of macrofossil samples were also collected and registered as Finds Units.

***Strategy for sampling and analyses:*** Only zoological material from defined archaeological features was analysed in line with the Danish Museums Law, according to which an analysis may only result in an identification of species, determination of type of bone and weight as well as a preliminary registration of i.e. cut marks, cleaving for the extraction of marrow and the effects of burning.

The material to be analysed was chosen during and following the fieldwork phase, according to its cultural-historical potential and sampling was done according to the previously described procedures. The decision to conduct the analysis was taken on the basis of the cultural-historical potential, and carried out in order to complement the interpretations made from the analyse of other source materials. Assemblages of special interest for the project objectives could however be analysed on an ongoing basis according to decisions made by the Excavation Leader and the Science Coordinator.

### 7.7.18 Macrofossil analysis

***Purpose of analysis:*** Plant remains can provide information on agricultural practices and food consumption, and are also useful for reconstructing the ancient environment and land use.

Macrofossil samples were generally taken as bulk samples, as well as some monolith samples. Bulk samples either included 100% of a smaller context or a minimum of 2 litres from larger contexts.

***Strategy for sampling and analyses:*** Sampling for macrofossil analysis was carried out according to different principles outlined for individual area types. The most ambitious sampling was undertaken in the areas where the cultural-historical potential was expected to be the highest. Neither funds nor logistics would permit every context to be sampled. In order to create a representative assemblage of source material; sampling was carried out consistently throughout the excavation, as far as possible – though as mentioned previously, there was a change introduced during the excavation, as the volume of samples was clearly going to greatly exceed that which could be analysed. Contexts to be analysed were chosen according to the relevant questions for the area type.

The features sampled included activity layers, floors and streets, the rampart and moats, ditches, pits and wells. Each sample was accompanied by a written justification stating why the sampled deposit should be analysed and how it was of relevance to the site objectives.

Some samples were assessed initially in the museum finds basement in conjunction with a consultant, in order to establish whether or not the sample had an organic content sufficient for analysis. Samples with no potential were discarded. All organic remains were created as sample units in IntraSiS. Decisions to analyse samples were taken according to cultural historical potential after the fieldwork phase.

The different sampling strategies within the various zones were carried out in consultation with the Excavation Leader/Field Leaders and the Science Coordinator.

### 7.7.19 Pollen analysis

***Purpose of analysis:*** Pollen analysis is undertaken in order to reconstruct the ancient vegetation and environment on site. Chronological pollen profiles can be used to detect man-made changes in the vegetation, such as forest clearance and field establishment.

***Sampling techniques:*** The extraction of pollen samples is done by the consultant and the analysis is done according to their recommendation. Pollen samples are ideally taken as bulk samples from vertical sections, but can also be extracted from monolith samples in the laboratories, or in a pollen core sample, taken by auger.

***Strategy for sampling and analyses:*** Pollen analysis was not employed on Kongens Nytorv, primarily as the analysis is costly, and also can be somewhat problematic in terms of the information gained.

### 7.7.20 Dendrochronology

***Purpose of analysis:*** Dendrochronological analysis can establish the date when a piece of timber was felled through the analysis of the growth rings, using reference samples as a guide. The origin (provenance) of the wood can also be established, again by examining the pattern of growth rings.

***Sampling techniques:*** Dendrochronology samples were extracted as sections with the aid of hand or chain saw. The width of the section was ideally not more than 15 cm and, if possible, it was important that the sample was taken where the sapwood and bark is preserved. Knots and branch ends were to be avoided. Multiple samples from the same piece of wood were taken if deemed necessary, and several from a given structure if possible. Archaeologists were responsible for extracting the samples. After obtaining the sample it was important that it would not dehydrate. This was especially important if sapwood was preserved. When the sample was extracted it was packed in a heavy plastic bag or wrapped in plastic film, to ensure that sapwood and bark did not dislodge. The timbers were stored out of the sun in a container on site, and as fast as possible transferred to the museum, where they were placed in a refrigerated storage container to await analysis.

***Strategy for sampling and analyses:*** Dendrochronological analysis was carried out when stratigraphy and finds material were insufficient to determine the age of a feature or object vital for the understanding of the site. Samples were analysed according to the cultural-historical potential during and after the fieldwork phase. Concerning archaeological features from the 17$^{th}$ century onwards, dendrochronological analysis was used instead of AMS as radiocarbon dating is ineffective from the mid 17$^{th}$ century onwards. Dendrochronological sampling on site was implemented on the vast majority of in situ wooden structures such as bulwarks, bridges, etc. At least one sample was generally taken from each defined structure including repairs and renewals. Re-deposited wood would not date a layer in which it was re-deposited, and was not therefore analysed. The decision to carry out the analysis was taken after the fieldwork phase and taken on the basis of the structure, its context and its cultural-historical potential, and carried out in order to complement the interpretations made from the analyse of other source materials.

### 7.7.21 Wood anatomy analysis

***Purpose of analysis:*** Wood anatomy is useful for the identification of species or types of wood present in the archaeological layers, thus providing a picture of the types of wood available to the inhabitants of the site.

***Sampling techniques:*** Analysis was carried out as a part of the macro and dendrochronology analyse (mainly the latter), and was thereby guided by similar principles.

***Strategy for sampling and analyses:*** The decision to conduct the sampling was taken on the basis of the object, its context and its culture-historical potential, and carried out in order to complement the interpretations made from the analyse of other source materials. In general, species identification is defined as part of the process of dendrochronological dating, and as a standard step prior to using wood or charcoal for C14-dating.

### 7.7.22 Geological analysis

***Purpose of analysis:*** Geological analysis can distinguish between natural and cultural deposits and investigate how they were affected by later natural processes and human activities.

ICP analyses of pottery can determine the chemical composition of the clay and thereby point out the geographical origin of the pottery. The method can also be used to identify metal remains in objects such as crucibles and moulds.

The analysis of thin sections and crystalline matter can determine how a clay pot was produced, including the type of clay and tempering being used.

Thermal analysis can determine the firing temperature of the clay or the pot – this analysis is used to determine the function of different types of ceramics as well as craftsmanship.

### 7.7.23 Entomological analysis

***Purpose of analysis:*** Insects are often relatively habitat specific and are thus useful indicators of environmental conditions, both natural and man-made. Water – or faeces – loving beetles, for instance, may be able to tell us about humidity levels or the presence of manure in stable areas.

***Sampling techniques:*** Samples for entomological analysis were collected as bulk samples.

***Strategy for sampling and analyses:*** While insect samples were taken on site from deposits thought to be relevant, it proved difficult in the post-excavation stage to find a suitable person to carry out the analysis. Some samples have however been stored, and it may prove possible in the future to analyse some of these, perhaps as part of a research project.

### 7.7.24 Soil micro-morphological analysis

***Purpose of analysis:*** Soil micromorphology is useful for determining activity events on floors and streets, as the finely laminated build-up of fill layers on floors and streets can be detected and interpreted under a microscope. The contents of a layer, in terms of, for instance, its mineral or organic material, can be analysed, and the preservation state of the material established. Processes of soil deposition (an in situ layer or colluvium) and human activity (ploughing, trampling, and burning) can be observed, as well as the presence of tiny fragments of material such as ceramics, charcoal, bones and manure.

***Sampling techniques:*** Some monolith samples were taken on site with a view to carrying out micro-morphological analyses, however, none of these samples were processed during post-excavation as they were not deemed likely to provide sufficient extra information in the particular instances.

***Strategy for sampling and analyses:*** Micro-morphological samples were taken on activity surfaces such as floors and streets. The Field Leader was responsible for contacting the Science Coordinator when such deposits occurred. The analysis is, however, expensive, and therefore samples were only to be taken from clearly defined contexts with high cultural-historical potential according to decisions made by the Excavation Leader, the Science Coordinator and the relevant consultant.

## 7.8 Photographic records

The photographic documentation primarily consisted of rectified images of different contexts, structures and finds, both in situ and at subsequent documentation. Additional images were taken to depict clear stratigraphical relationships between different contexts and overall images of work on site.

The Excavation Leader and Field Leaders were responsible for ensuring that the methodologies listed below were employed. These methodologies were implemented and overseen by the person with special responsibility to maintain the photographic archive and manage the photography at Kongens Nytorv. The excavating archaeologist took images, while the responsible person imported these to the database and project folder, recorded relevant data and related the photo to the relevant context or feature.

Procedure: *Archaeologist* ➔ *photo; Photo responsible person* ➔ *import to IntraSiS and project folder*

A complete photographic archive was maintained throughout the excavation. Image registers were created in the field. Recording consist of an Image number (which was cross-referenced on the context sheet together with the camera number), context numbers, area, direction of image (facing), comments, initials and date. On the main excavation this reflected the single context recording system being used to document the site, i.e. representative and illustrative features were photographed. Further to this, images of larger areas and overview photographs were taken at appropriate times to illustrate key relationships and to allow for a coherent visual examination of the site at report stage.

Working shots were taken where appropriate; this served a number of functions, particularly to populate the site, for future dissemination and to document the process of excavation. The photographic record was sufficiently thorough and detailed to illustrate all significant phases, structures, important stratigraphic and structural relationships, and individual items of interest, including artefacts. The latter were photographed in situ where deemed appropriate e.g. if it was likely that the object may not survive the excavation process intact, or if its find location was deemed to be of particular significance. Timber for dendrochronological analysis, wood working analysis and further recording was photographed. This also included several bricks and limestones.

At the watching briefs the photographic archive reflects the methods employed. Excavation of these areas was not generally carried out using the single context system, hence the photography was more general – mostly overview images and where individual contexts did not necessarily require individual photographs.

Rectified photographs were taken of contexts and structures that were too time and work consuming to record through measurement with the total station or drawings, such as road surfaces, part of the city wall and the Early medieval bulwark. Some video sequences have been made showing both the work process, but also for public use such as future exhibitions, etc. (i.e. wooden water pipes in subarea phase 45B).

At two of the subareas (phase 5B-2 and phase 45B) an image was taken every day from the same location following the excavation from the beginning to the end (Today's Photo).

A separate folder has been made by the Collection Department containing selected and conserved finds.

As far as possible, all images are of publication standard, with guidelines provided to all members of staff to ensure a good degree of uniformity of composition e.g. a majority of the site photographs, except working shots, included a photographic scale of appropriate size. Images were taken using digital single-lens reflex (DSLR) cameras (a 10.2 megapixel Nikon and a 12.2 megapixel Canon). The digital images were downloaded at regular intervals, generally weekly or more frequently as deemed necessary. The images were renamed and catalogued according to camera number, date taken and file number, e.g. C03_20100114_031 (representing image No. 31 taken on camera 3 on the 14$^{th}$ of January 2010) using the Canon software ZoomBrowser EX.

These images were then transferred to different folders (Images 2009–2016; Working Shots; Rectified and 3D and Today's Photo) on the terminal server for storage and security:

T:\KBM3829_Kongens Nytorv\Images

Initially all failed photographs were deleted, but these were later saved to minimize inaccuracies at the later registration and renaming.

A written photographic index was compiled relating site photograph number, context numbers, excavation area, date taken, and a brief description including any other relevant information. This index was later cancelled to rationalize the work. Scanning of photo books Camera 1, 2, 3, 7, 10, 31, 32 and 116 (21) was also done by the person responsible and transferred to the terminal server.

Furthermore, photographs deemed of sufficient importance or of key interpretive value were linked to the IntraSiS database for the site (Images 2010 and 2011). This linking was done in relation to the particular context in question, with the image being displayed as a thumbnail related to that particular context. This thumbnail was linked to the original full size image in the main photographic archive. The rest of the photographs were also connected to IntraSiS, but only by the project folder transferred to the Terminal Server, due to the size (more than 100 GB). Photographs that were not linked to IntraSiS (i.e. Images 2012–2016, Working Shots, Today's Photo, Films, etc.) were nonetheless retained in the main digital site archive as part of the complete site archive and can be added to IntraSiS at a later date if required.

## 7.9 Wet sieving

### 7.9.1 Staff and methodology

The wet sieving was carried out at Kongens Nytorv and K-Vej 19, Prøvestenen during five periods; first in September 2010, second between May 17th and July 8th 2011, third from November 14th to December 23rd 2013, fourth from November 13th to 19th 2014 and fifth from January 25th and March 23th 2017.

The work between May 17th and July 8th 2011 was carried out by eight different people, where some were replaced early in the sieving process. Unfortunately a shortage of staff was a problem from May 31st to June 9th and again between the 17th and 23rd (Fig. 20). The later work, facilitated between November 14th and 23rd December 2013, was carried out by five different people, of which no-one was replaced. However, due to other obligations the shortage of staff was a lasting matter this time.

Fig. 20. Sieving in progress at Prøvestenen 2011. Photo: Museum of Copenhagen.

It is estimated that c. 100-110 1m$^3$ bags, collected at Kongens Nytorv, were meant for wet sieving. The main purpose was to maximize the recovery of small items such as small shards of pottery, coins, bone fragments, flint flakes, etc. This method allowed the quick removal of a context by machine, shovel and mattock yet allowed for a high retrieval rate. Additionally, extensive time pressure during the excavation work, especially in relation to the work in phase 5B-1, phase 5B-2 and the Station Box was taken into account during the sampling process. Hence most soil was collected during phases of work that were subject to a tight time schedule.

Spoil was shovelled into big bags and later soaked on top of sieves to form a slurry. The soil was poured into a sieve where the lumps of soil were carefully broken up and poured through a screen mesh sized either 1 mm or 5 mm.

The equipment, which was bought at UV-Syd in Sweden, consisted of four aluminum-built sieves, i.e. frames (c. 0.7 m x 0.5 m) onto which a 5 mm net was mounted. The frames were resting on four-legged stands. Water for the sieving process was provided by garden hoses that were connected to a larger main hose (not high pressure). Hence, the system made it possible for four people to work simultaneously.

However, in order to keep the opportunity to carry out more detailed sieve analysis, a 4 l bag intended for 1 mm wet sieving and natural science (fish bones) were collected out of each sample and returned to the finds basement for further analysis during the sieving process.

As the sampling was facilitated under massive time pressure huge loads of soil were collected. Consequently, the task of sieving all the samples did by far exceed the resources. Prioritizing the bags was of the essence and the sampling from the supposedly oldest deposits, i.e. usage layers from the 16th and 17th century moats, were prioritized, as the fieldwork had shown that these deposits only contained a sparse amount of artifacts, therefore additional data was desirable.

The fundamental prioritization was based on a wish to retrieve datable material. However, specific sample motivations made by the Field Leaders could include special requests for finds retrieval, i.e. explicit focus on fish bones.

Basically all cultural related finds were collected, but because the amount of bone material was rather extensive the retrieval had to be dealt with in a less rigid manner than traditionally. Hence time saving was a topic during the sieving procedures.

The samples were sieved bag-wise and the retrieved finds were sorted according to type of material and labelled accordingly. Subsequently, the finds were handed over to the museum (finds responsible) the same day if the risk of rapid disintegration was imminent. If not, the finds were turned in at the end of the week. The finds were stored in a controlled environment in the finds basement.

Other work tasks were also facilitated. Hence, entering sieving data in IntraSiS was carried out by the person responsible alongside the sieving procedures.

### 7.9.2 Results

Multiple finds were made, more than one thousand. However, the exact number was not recorded. The most commonly made find category was faunal material, i.e. bones. On the other hand brick fragments in various sizes and pottery pieces were the most common cultural remnants retrieved during the sieving procedures. Besides these bulk finds some handfuls of more elaborate finds (special finds) were made too, i.e. a High medieval langtandskam (long tooth comb) made of bone; three cloth seals, etc.

## 7.10 Tours and press

The archaeological excavations at Kongens Nytorv have been the object of a lot of attention from both the public and the media. Especially during the stages of excavation in 2010 and 2011, the Kongens Nytorv site got a lot of media coverage. An archaeological excavation of this size had never been carried out in Denmark before, so this in itself was a natural cause of attention. Also the location which is in the heart of current Copenhagen made the investigations obvious to most Copenhageners and tourists.

Fig. 21. Field archaeologist Kirstine Haase doing one of the daily tours for a large crowd. Photo: Museum of Copenhagen.

The interest from the public was huge and very positive. People were interested in the archaeologists' work and the findings. A lot of the archaeology carried out on Kongens Nytorv was "large scale" archaeology, which meant that quite a lot of big structures were excavated. The fact that the medieval eastern gate and fortification had been under the pavements of Kongens Nytorv for so many years, did in fact make a great impression on the public. The big structures made it easier for the public to understand what the findings represented.

The huge interest from the public resulted in an agreement with the Metro Company, that the Museum of Copenhagen did a minor public presentation outside the excavation area every day (Monday-Thursday) at 1:00 PM (see Fig. 21 above). One of the excavating archaeologists would meet the public and give a small tour of the site and an update on results. They would also bring a small collection of artifacts found on site to show. These daily tours took place from the 10th of January 2011 till the 29th of August 2011. In the summer of 2011 tours in English were also made for tourists. These took place from the 14th of June 2011 till the 29th of August 2011. Especially the tours in Danish were an overwhelming success and some days there would be up to 200 interested listeners. This of course made it a bit difficult to reach out to everybody who showed up, but in general it went really well.

Fig. 22. Field archaeologist Claus Rohden Olesen being interviewed by the media. Photo: Museum of Copenhagen.

The media attention was quite intense during the main excavations in 2010 and 2011 (Fig. 22). The most media coverage was in the newspapers; national newspapers like Politiken, Berlingske Tidende, EkstraBladet, BT, Kristeligt Dagblad and local papers like Cityavisen, Flensborg Avis, etc. Also internet news sites and scientific sites like videnskab.dk carried stories on the excavations.

The TV media was represented by DR TV-Avisen, TV2 Nyhederne, TV2 Lorry and DK4. Also videos on Youtube.com produced by the Museum of Copenhagen and archaeologists on site were made. The radio station P4 also made reports from the excavation.

Separate tours of the site were made by institutions: Kulturministeriet, Slots og Kulturstyrelsen, Kultur-og Fritidsforvaltningen Københavns Kommune, Aarhus University, Copenhagen University, the National Museum of Denmark, the School of Conservation, the Metro Company, different archaeological museums and companies in Scandinavia, etc.

## 7.11 Archive, storage and processing facilities

In accordance with the guidelines issued by KUAS, site and research archives from excavations in the Kongens Nytorv area are archived at the Museum of Copenhagen (KBM).

All finds and field records are processed and curated by the museum and are available for public consultation. In addition the digital archive is stored and maintained on the terminal server in IntraSiS, Microsoft Word and images in tiff-format at the terminal server:

T:\KBM3829_Kongens Nytorv

The archive includes all materials recovered (or the comprehensive record of such materials as referred to above) and all written, drawn and photographic records relating directly to the investigations undertaken. This is quantified, ordered, indexed and internally consistent and contains a site matrix (where generated), a site summary and brief written observations on the artefactual and environmental data. Copyright of the complete written archive is vested with the museum.

The storage and processing facilities can be summarised as follows:

- All paper and digital records are initially stored under the appropriate environmental conditions at the museum's offices at Vesterbrogade 59, 1620 København V (2016).
- Following analysis and publication, the museum will store and maintain all finds and archival material.
- The finds details are laid out in Chapter 7.6 and in the Finds Handbook (2010).

The physical archive consists of 23 A4 folders containing paper records of the site; this includes the field context sheets divided by subarea; phase 1N, phase 1S, phase 1W, phase 2+3, phase 3, phase 4B, phase 5A-1, phase 5B-1, phase 5B-2, phase 45A, phase 45B, phase 6A-E, Station Box 2012–2014, Bitrappe and Ventilation Shaft 2016, MCW, watching briefs, wet sieving and incomplete and cancelled context sheets. Two A3 folders contain mostly drawings of sections, but also some drawings in plan.

To this is added one folder for Press material, Dissemination and Metro Drawings.

There are 22 books which contain the image register (Museumstjenesten). These books have been scanned and saved digitally in the project folder. There are also 11 survey books with the recordings from the total stations (Survey Book 2206 and Moleskine). All books have been scanned. Some of the personal diaries have been saved.

The digital archive consists of all files in the project folder on the museum terminal server under the museum number for the site – KBM3829. Digital copies of this report are stored in this folder.

There is also the main IntraSiS file (Project File K201001) which consists of the surveyed geo objects and the contextual information entered from the context sheets, with associated rectified and digitized historic maps.

There are 116.06 GB of digital images from the site. A total of 16 719 images were taken on site, and with some exceptions, all of these were saved and kept in the archive. Out of the saved and kept pictures 8 597 were registered (630 resized) and put into IntraSiS.

## 7.12 Source criticism

A number of source-critical aspects are current during an archaeological excavation. They can be divided into two main types: object-related and investigation-related. The first group varies depending on what is being investigated, how the feature is stratigraphically built up and its preservation conditions, while the second concerns excavation conditions, the investigators' skills, equipment and strategy and weather conditions.

From an archaeological point of view, a city is a very complex case. It represents a settlement that has been localised to a small area for a long time. There are a large number of traces and remains that, under time pressure, have to be managed and transformed into structured and usable source material. The conditions are partly dependent on the features' preservation degree. These are on the other hand related to the conditions of preservation that have existed; geological, what types of materials are included in the stratigraphic units and later deconstruction activities.

Preservation conditions in the excavation area varied. In general, they were relatively good although only if coarse organic material was partially preserved. The surface was highly fragmented as a result of a number of truncations of different age.

The conditions are also dependent on secondary influencing factors, i.e. the degree to which the sequence is fragmented by later interventions. Contemporary and younger activities, such as when the plots were reorganized or the creation of larger fortifications, have fragmented older stratigraphy or caused accelerating decomposition rates. Degradation, or incorporation, is the result of changes to the deposit conditions by oxygen, microbiological activity or liquid ratios.

A layer consists of an upper and a lower contact area as well as a content that constitutes its structure. As decomposition occurs the contact surfaces will be less distinct. Definition and delimitation thus becomes more difficult and are more time consuming for the investigator. Complexity and fragmentation also means that the stratigraphic objects have a very large number of physical relationships that continually need to be processed to create logically valid and usable source material.

The majority of the staff consisted of archaeologists with experience of urban archaeological excavations and the single context method. They quickly learnt the documentation and operating procedures set up for the excavation. The quality of documentation was high, though interpretation and grouping work could not be made continuously during the field survey as planned, since changes and priorities in the original time schedule, together with the archeological material meant that excavation work was given priority for the benefit of other on-site related work tasks. Registration and IntraSiS responsible positions were held by highly experienced staff from the Museum of Copenhagen.

The weather was mostly good through the entire period from December 2009 to December 2016, despite a cold and snowy winter 2010–2011. An unknown number of work days were lost due to rain, snow, flooding and contaminated/polluted soil during the field season. Especially the flooding on July 2nd 2011, which caused considerable and extra cleanup work in the excavation areas (Fig. 23).

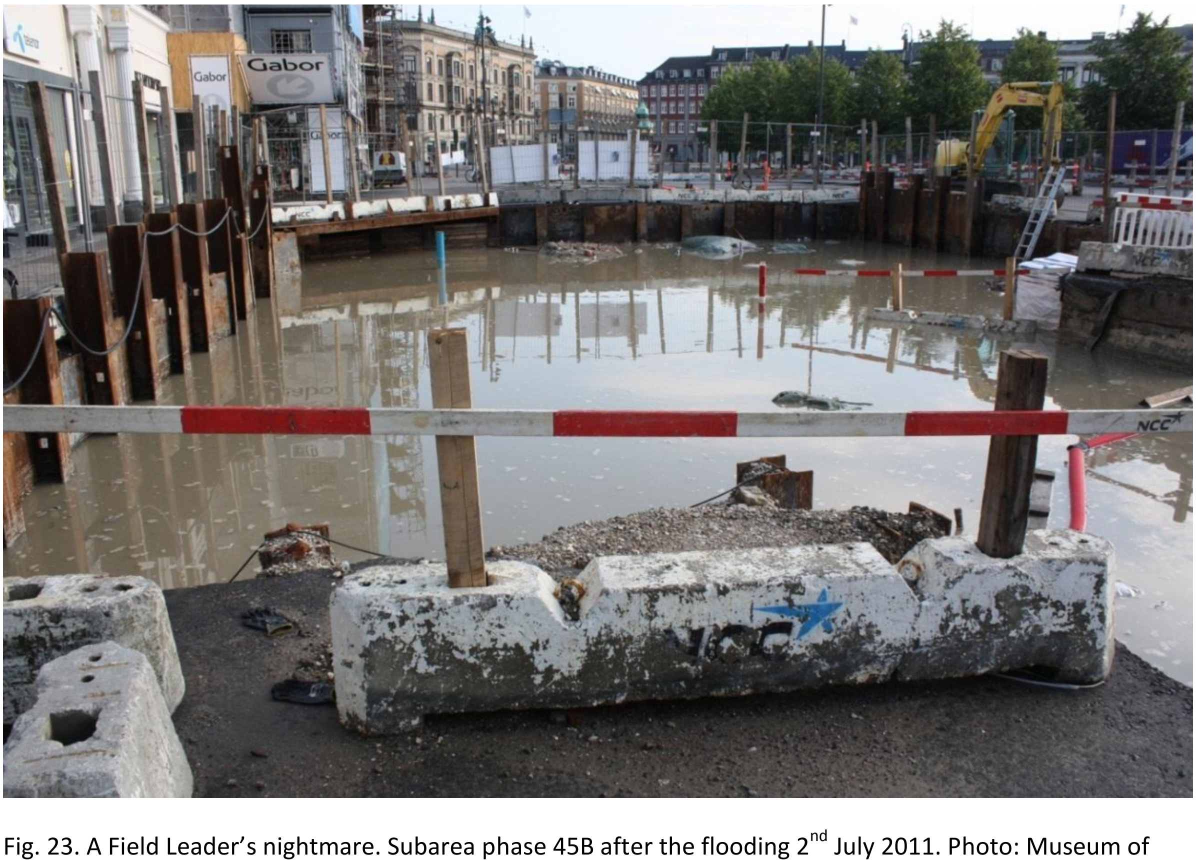


Fig. 23. A Field Leader's nightmare. Subarea phase 45B after the flooding 2nd July 2011. Photo: Museum of Copenhagen.

### 7.12.1 Features and preservation

With the exception of stray finds dated to the Late Mesolithic and Neolithic periods (Phase 2), the oldest archaeological remains at Kongens Nytorv can be dated to the Late Viking Age/Early medieval period (Phase 3). From earlier excavations such as the Metro investigations in 1996–1998 and sampling from areas close by, as well as geological observations in the area, we know that during the Viking Age and Early Middle Ages the area was situated considerably closer to the sea shore than today. The general notion is that the area was marshy and perhaps affected by temporary flooding (Chapter 3; Regional geology and topography), but the proximity to the sea would have made it an attractive area for fishing activities, pastureland and possibly limited settlement.

The Early medieval remains are naturally most affected by later activities. Since this was the site of the eastern part of the city from the early 13$^{th}$ to the mid 17$^{th}$ century, huge and several truncations were made in the ground and large stone structures were built, in order to dig moats and to create new fortifications and gates. This applies for example to the area around the 17$^{th}$ century fortification (Østervold), where the ground was levelled and prepared before further construction.

Later on, when the area was made into a square, the area was cut through with numerous modern services, destroying even more of the medieval features. Due to these circumstances, the remains from this period were fragmentary and may not be representative of the full range of original medieval activities, especially in the area east of the medieval fortification and outside Østerport. Large truncations had destroyed the ground level from the time in large parts of this area, leaving almost only the deeper features and the deposits filling them preserved.

Even though the remains were fragmentary, the excavations provide important information about life in medieval Copenhagen, which is previously unseen in the archaeological material from the city. Phase 3 is characterized by post-city activities, and the stratigraphical information and spatial analysis, together with finds material and scientific datings show a busy area within the timeframe of the phase. At least two sub-phases have been identified; mainly based on structural evidence for boundary ditches and so-called clay lined pits, but it is difficult to prove whether these represent a re-organization of the area.

The High and Late medieval fortifications were documented in a stretch of c. 50 m running in a north-south direction (Phase 4). Large parts of the city wall foundations had been removed in connection with a Transformer Station in the 1940s (see Fig. 91). The Late medieval moat had been truncated both by later fortification activities and by modern disturbances such as a large Transformer Station to the north, shoring and a large concrete structure to the south, and the limited working space within the excavation area made the documentation difficult sometimes (Fig. 24).

Fig. 24. Not the best excavation conditions – removing Late medieval moat layers in subarea phase 5A-1, facing south. Photo: Museum of Copenhagen.

The medieval gate building had been heavily affected by the later 17th century Østerport being placed at the same spot, and by the 17th century fortification and the surrounding, modern shoring. The later version of the gate building together with a dam, a barrier tower and five bridge foundations (Phase 6) were also heavily truncated by later robber pits and several modern disturbances (pipe lines, shoring, Guide Walls, etc.). The latest version of the inner gate building and one of the recorded buildings outside the moat (building No. 1) were especially heavily truncated by robber pits, re-using the different materials for building activities around the city. The 17th century remains of the moat were not that heavily impacted by later activities in the area such as the establishment of the square in the mid 1600s, but at some places was truncated by modern bunkers from the 1940s, service trenches, etc.

The High and Late medieval features in Lille Kongensgade in the area behind the medieval rampart (Phase 5 and Phase 7a) had been heavily affected by modern truncations, which meant the buildings, street surfaces and other activities in this subarea were quite fragmentary, but also difficult to interpret due to the excavation methods close to Hviids Vinstue.

Dealing with the 17th century structures and later features at Kongens Nytorv (Phase 7b and Phase 8) one must also have in mind that the Station Box including the Guide Wall trenches, the Bitrappe and Ventilation Shaft (Type 3 and 4 areas; Field season 2012–2016) were watching briefs mainly using machines to expose and excavate both larger and smaller structures, with the exception of the settlement outside the 17th century moat including several buildings, road surfaces and alleys (Fig. 25).

Fig. 25. Overview Guide Wall trench with part of the bastion and 17th century moat, facing NE. In the left handside corner – modern sand in a central heating trench. Photo: Museum of Copenhagen.

The intense usage of the area and degree of restructuring of activities had resulted in a high amount of intercutting and re-deposition of material during the medieval and post medieval period. This is obvious in the finds material, where later pottery is found together with, or stratigraphically below deposits and features of older date. Also, this should be seen in connection with some of the AMS-datings, which are on the whole earlier than some finds from the same context. These circumstances make the phasing of the activities ambiguous and therefore spatial relationships between archaeological features have sometimes been accorded more weight than the observed stratigraphy. In general, dating of contexts is based on a collective assessment of stratigraphy, datable finds, dendrochronological or radiocarbon dates (where available) and spatial relationships.

It should be noted that the “absolute” dating of levelling deposits can be ambiguous, since they may consist of a mixture of deconstruction material from several building phases, depending on the deposition history and number of building phases at the exact spot. This is often shown in the very broad date range of the finds within what is interpreted as the same levelling deposit.

# 8 Phases and chronological development

The following chapters are a methodical description of all time phases excavated at Kongens Nytorv from 2010–2016. The chapters will describe the most distinct archaeological features of every time phase and discuss and interpret the results. A full listing of all archaeological features/groups in each time phase is presented in Appendices 1-12. The following chapters are written in this manner to make the presentation of the overall interpretations of each time phase more manageable.

## 8.1 Phases

The archaeological results are presented chronologically, but in order to provide an adaptable overview, the time phases have been sorted in areas that make sense in both time and an archaeological frame (Fig. 26).


Fig. 26. All measured features at Kongens Nytorv marked with black lines.

The presentation of the time phases has been split up into three main areas; behind the fortification, the fortification and outside the fortification. The fortification in all its phases was the dominating feature in phases 5A-1, 5B-1, 5B-2, 45A and 45B and large parts of the Station Box including the Ventilation Shaft (Fig. 27). This means that the distribution of the different phases is split up in time phases like this:

**Phase 1 Moraine, salt marshes and other Quaternary observations:** All phases.

**Phase 2 Prehistoric finds and features:** All phases.

**Phase 3 Early medieval activities 1050–1200 AD:** Phase 4B, 5B-2, 45A, 45B and Station Box.

**Phase 4a High medieval fortification 1200–1350 AD:** Phase 4B, 5B-1, 5B-2,45A and 45B.

**Phase 4b Late medieval city wall 1350–1550 AD:** Phase 4B, 5B-1, 5B-2, 45A and 45B.

**Phase 4c Eastern gate building 1200–1600 AD:** Phase 1N, 5A-1, 45A, 45B and Station Box.

**Phase 4d Late medieval and Renaissance fortification 1350–1600 AD:** Phase 1N, 5A-1, 45A, 45B and Station Box.

**Phase 5 High and Late medieval activities 1300–1500 AD:** Phase 1S, 2+3, 6, 4B and 45B.

**Phase 6 Post medieval fortification and eastern gate building 1600–1650 AD:** Phase 5A-1, 5B-1, 5A-2, 45A, 45B, Station Box and Trench ZT1196.

**Phase 7a Settlement and activities behind the rampart 1550–1650 AD:** Phase 1N, 2+3, 4B, 5B-1, 5B-2, 45B and 6.

**Phase 7b Outside the moat. Settlement and activities 1550–1650 AD:** Station Box and Bitrappe.

**Phase 8 Kongens Nytorv 1650–1950 AD:** All phases.

The time phasing of the features is based on mainly stratigraphy, dating of finds, dendrochronology, C14-dating and to a minor extent spatial relations.

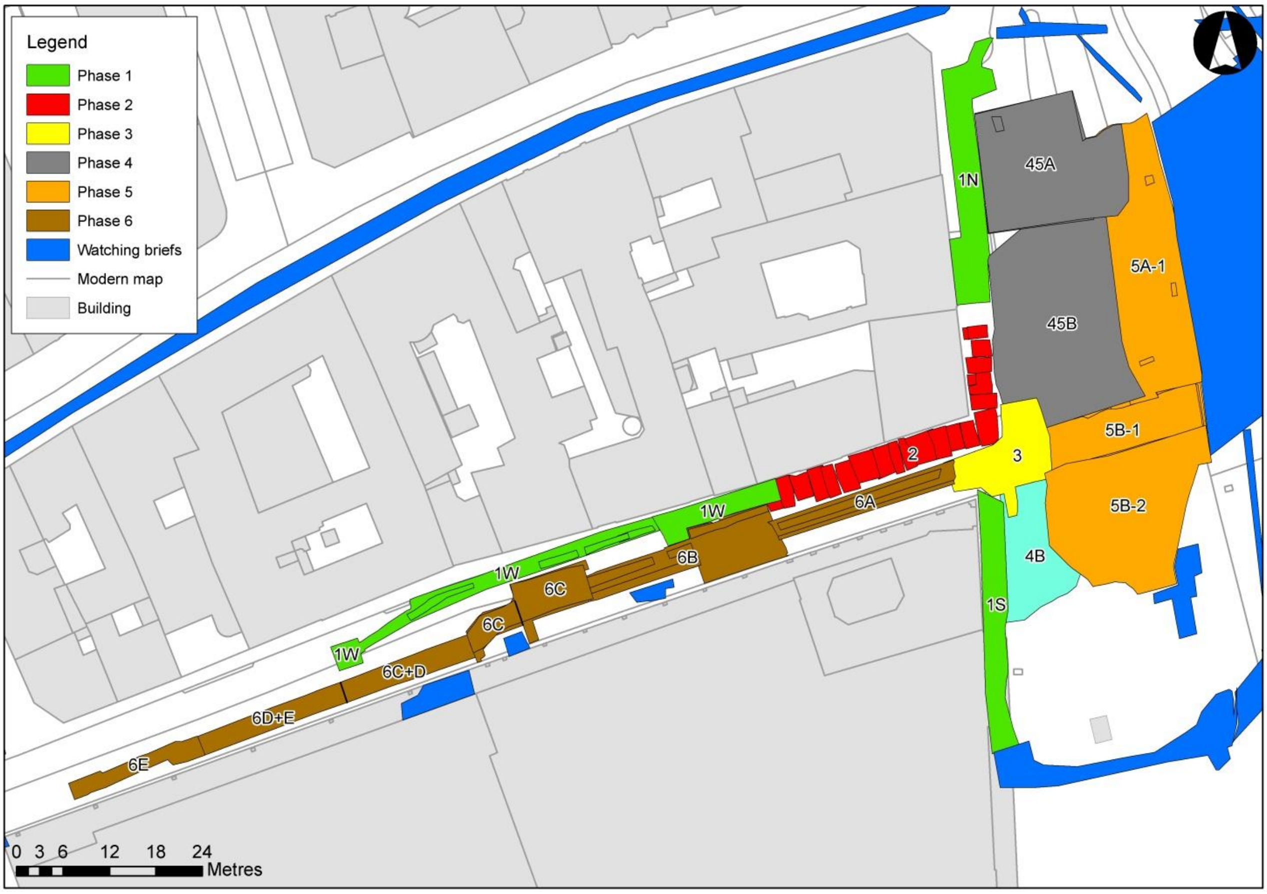


Fig. 27. Excavation at Kongens Nytorv with type 1 and type 2 areas.

## 8.2 Chronological development

As an introduction to the next chapters a short history of the site of Kongens Nytorv is presented here in chronological order.

Before Kongens Nytorv was inhabited by people, the area was dominated by salt marshes with the original coastal meadows that were documented archaeologically as a dark layer on top of the natural sand and clay/natural ground. There are only a few traces of cultural influence and the area had probably been used for grazing of livestock. The prehistoric period is represented by finds of worked flint and even though most flints occurred in secondary contexts, it points to the presence of a fragmented near-shore settlement at Kongens Nytorv. The dating of the collected finds points to the Late Mesolithic and Neolithic periods.

The first clear human presence documented at Kongens Nytorv is from the Early medieval periods before 1200 AD. Ditches parallel with the present north-south line interpreted as plot markers and pits that might have been used for storage were excavated. The most interesting features in this period are the clay lined pits and they are placed in the mid 12$^{th}$ and early 13$^{th}$ century based on AMS-dating. Their function is not clear, but similar pits documented on the coastline in Scania indicate that they have been used for storage or preparation of herrings in connection with fishing in Øresund.

The first phase of the city fortification can be dated to the early 13$^{th}$ century. This consisted of a rampart built using material dug up in connection with establishing the moat. Traces of a probable stockade "*Byens Planker*" were registered in one of the two earliest phases of the rampart as well as a 17 metres of bulwark (dated dendrochronologically to the early 13$^{th}$ century) to support the rampart on the edge of the moat.

The key feature in the fortification was the eastern gate (Østerport), of which original parts date to the time of the first phase of the fortification in the early 13$^{th}$ century. The building was maintained and remodelled several times until it was demolished in 1608. Through the gateway several road layers with wheel ruts were preserved. Road layers were also documented in connection with the inner gate building – both in connection with the rampart street and outside the Late medieval moat.

Just south and in connection with the eastern gate the foundations of a customs- or guard building was excavated and the dating of this falls in the 14$^{th}$ century.

Following the interpreted outline of the *"Byens Planker"* a brick built city wall was erected which is difficult to date but is likely to originate around 1350 AD. The city wall could be traced for a length of 19 metres. Remnants of the wall found in other parts of the excavation area suggest that the city wall had merlons.

In the early 17$^{th}$ century the eastern gate and the guard building are renewed and expanded in the exact same spot as the medieval gate. The entire medieval fortification is replaced with a new and larger fortification and part of the bastion, the curtain running along the new 17$^{th}$ century moat and five of the bridge pillars across the moat were excavated. This fortification does not last long, and by the middle of the 17$^{th}$ century it is abandoned.

Behind the medieval fortification settlement and boundary ditches can be followed continuously from the 13$^{th}$ century onwards till the present day. There is evidence of permanent housing, streets, wells, pits and other traces of urban environment. Also the remains of a forge were excavated. The findings indicate that the area was relatively modestly used, when compared with other findings in urban Copenhagen. This can also be a result of modern disturbances.

By the middle of the 16$^{th}$ century and until the final destruction of the Post medieval fortification, a settlement existed outside of the moat. At least two buildings were excavated and also traces of possible gardens, alleys, boundary fences and roads with wheel ruts were documented.

From the middle of the 17th century and to the present day observations of predecessors to standing buildings around Kongens Nytorv were observed. Also building remains from the Lille Gjethus (the cannon foundry) from 1698 were excavated. Last, to be mentioned are two modern features, bunkers from the Second World War.

# 9 Finds

Finds in an archaeological excavation are of great importance – for dating layers and they can also tell something about the different kinds of activities in different areas or constructions. It is of vital importance to note that almost all finds from an archaeological excavation come from secondary deposited layers. Only a very small percentage of the finds come from primary layers like for instance floor layers or road layers. This is also the case with the finds from Kongens Nytorv, where a lot of layers are secondary deposits on site. These being dump layers, levelling layers and fills in pits or deconstructed postholes. In some cases it is more likely that the secondary layers come from the nearest surroundings. These being fills in pits, postholes and perhaps also the moats. Larger levelling layers and fills in boundary ditches can be moved from places further away since this kind of work would demand a larger volume of soil or dump material. This means that using the finds for dating layers or identifying activity has to be carefully approached.

The excavations at Kongens Nytorv did not produce as many finds as was expected before the project. The excavation at Rådhuspladsen produced 17179 FO-numbers and Gammel Strand excavation 9689 FO-numbers[3]. With 11154 FO-numbers Kongens Nytorv has fewer finds than the two other major sites at the Metro Excavations. It is important to note in this comparison that an FO-number often contains more than one individual find (for the registration of finds see Chapter 7.6; Finds procedures).

It makes most sense to compare the two sites Rådhuspladsen and Kongens Nytorv since Gammel Strand is a habour front area with multiple fillings between bulwarks. Fillings that are categorized as dump layers. Rådhuspladsen and Kongens Nytorv are both settlement areas on the edge of the city with traces of craft work, pits, roads, houses, fortifications and moats, etc. The main difference is the dating of the settlements, which is younger for Rådhuspladsen (dates 1050 AD –). There might also be some differences in the archaeological method on excavating the moat. At Kongens Nytorv most of moat was dug mainly by machine and big bags of fill layers were taken out for sieving in a sampling strategy (see Chapter 7.7; Sampling and analytical procedures). But in general the area at Kongens Nytorv does not carry evidence of a very tight and massive settlement and the area is very much dominated by the fortification both in the medieval and Post medieval period.

The moats generated the greatest amount of finds. Due to gradually filling up, the moats have been cleaned at several times while in function, and this means that the finds to some degree have been moved around in the moats. The finds have most likely been dumped in the moats – some of them one at a time – for instance a broken toy or a drinking vessel. But it is also most likely that citizens of the city would dump larger amounts of garbage in the moats even though this was likely forbidden by law.

In general the finds at Kongens Nytorv were in excellent condition when excavated. The moist layers in the area caused by the nearness to the former coast line and present water canals made the circumstances excellent for finds to be preserved in the layers. Of course finds – and primarily the organic finds – were in fantastic condition from the moats.

The finds were prioritized for conservation, but since organic finds of bone, wood, textile and leather in such a good state of preservation are rare and the fact that they represent unique findings (one of a kind), many of these were prioritized for conservation. Also metal finds were fairly well preserved and therefore prioritized for conservation, but many of these were nails or unidentifiable artifacts. Quite a lot of these were still unidentifiable after X-raying, but some of these have been kept for future research or identification.

[3] A large amount of the ceramic find units (around 50%) from this site did not get a FO-registration due to prioritation of the material (cf. Whatley 2016:57).

Due to prioritation of the project, few finds are registered in the IntraSiS database and part of the total count of finds but not analysed and described in the finds reports.

## 9.1 Distribution of finds

The finds have been sorted into subclasses and classified by function using function types that are similar to categories seen in the NORM registration and Museum of London registration systems. The distribution can be seen below (Tab. 8). Animal bones and shell-molluscs (Number of FOs 16381) are not presented in this table.

| Finds Subclass | Examples of types of finds | Number of FOs |
|---|---|---|
| Medieval pottery (1060–1535 AD) | Pottery dating from medieval periods from c. 1050–1535 AD | 442 |
| Post medieval pottery (1536–1800 AD) | Pottery dating from the Renaissance period (1536–1660 AD) and later Post medieval period (1661–1800 AD) | 5978 |
| Stove tiles | Decorated and undecorated tiles from stoves | 515 |
| Leather | Various types of clothes (non military), shoes, slippers | 550 |
| Textile | From clothing to household furnishings, i.e. covers, curtains, etc. | 108 |
| Glass | All types of glass vessel and window glass | 537 |
| Slag and other metallurgical waste | All by-products of metalworking | 159 |
| Wall tiles | Decorated and undecorated tiles from structure | 23 |
| Household equipment | A selection containing wooden house furnishings to metal storage items, barrels, buckets and cooking and non ceramic storage objects | 230 |
| Arms and armour | Military weapons, projectiles and armour | 90 |
| Coins and tokens | Coins and various trading tokens | 38 |
| Personal items | A broad category representing finds linked to the individual, i.e. jewelry, badges, brooches, religious, buttons, etc. | 55 |
| Combs and comb cases | Combs and comb cases from all periods from all different materials | 10 |
| Toys and games | An assemblage of all types of toys, games, gaming boards and gaming piece fragments | 63 |
| Horse equipment | All types of equipment for the horse, i.e. horseshoes, nails | 14 |
| Tools | All various craft tools and equipment linked to industry | 129 |
| Ships and fishing equipment | Finds covering the broad spectrum of maritime archaeology and fishing equipment | 18 |
| Security equipment | Archaeological equipment comprising various types of keys, locks and draw bars | 11 |
| Textile production tools | Crafts persons equipment linked to textile production and repair, i.e. pins, needles, thimbles, needle cases, etc. | 66 |
| Trading equipment and cloth seals and other seals | Cloth seals, trading stamps, various trading objects outside of glass and ceramic finds objects | 26 |
| Writing equipment | Slates, pens, stylus, stylus cases, wax slates | 7 |
| Knives and cutlery | Domestic knives and knife and handle fragments, table knives, spoons and forks | 65 |
| Flint | Flint tools, gun flint and percussion flint | 109 |
| Clay pipe | Clay pipe fragments, pipe production equipment and figurines | 574 |
| Rope | Rope fragments | 35 |
| Building materials | Roof-, floor-, ridge tiles, bricks and other building related materials. Various statues and decorated fragments of stone | 645 |
| Unidentifiable objects | Various finds, either unidentifiable or corroded through soil | 245 |

| | | |
|---|---|---|
| | conditions. Also finds not subclassed. | |
| Other | Off-cuts, nails, other organic, skeleton | 412 |

Tab. 8. Kongens Nytorv. Finds subclasses, types of finds and numbers.

## 9.2 Conclusion

By far the largest finds category is ceramics, and in order to say something general about the finds at Kongens Nytorv and socioeconomic status of the area it is an obvious first place to start. The medieval ceramics date from around 1100 AD and up until the start of the 14th century there is an absence of imported pottery that is very common in this period in other urban societies in Denmark and southern Scandinavia. The largest amount of medieval ceramic dates to 1200–1450 AD which might indicate a higher level of activity in the area, and ceramics dating before 1200 are very few (Fig. 177). From 1350 there seems to be an increase in ceramics that indicate a rise in status of the area suggested by the increasing more mercantile/Hanseatic influence on the material.

45% of the total amount of the ceramics found on the site dates to 1550–1650 AD and there is evidence of local production from 1500 onwards, but also a larger amount of imports from the Netherlands, Germany, France and Italy (Fig. 28). The area seems at this point to be on a higher socioeconomic level with a larger diversity in the ceramic material. Even Chinese porcelain is registered in the material before the official trade with China in 1730. That said the ceramic material was still dominated by kitchen vessels and also trays and jugs. Things that are attached to everyday life both at the higher and lower ends of society.

Fig. 28. Stoneware sherd from Cologne 1566 (FO206929). Photo: Museum of Copenhagen.

The mercantile influence traced in the later medieval ceramic material can only be traced to a more modest degree in other material like glass, coins and cloth seals.

The ever-present fortification does leave some traces in the finds material. Traces of musket balls and iron cannonballs were found, some of them had actually been used and hit a target. The conclusion from the finds specialist is, that despite these finds, the amount of similar finds would be expected to have been larger. A collection of children's toys were also excavated from the moat, such as the little toy boat seen in figure 29 below, indicating that everyday life also played a major role around the fortification.

Fig. 29. Wooden toy boat (FO200948). Photo: Museum of Copenhagen.

In general the finds from Kongens Nytorv are what to be expected from most (larger) medieval and Post medieval urban contexts. There are signs of imported goods and artefacts, but considering the fact that Copenhagen in the Post medieval/Renaissance period was a fortified trade town, the amount of finds from a city of this status is rather few.

There is also a limited amount of prestige finds which would have been owned by the more prominent citizens like the bourgeoisie and courtiers that are present in the city from the Late medieval period. Instead there are traces of craft work like the forge and finds of slags and a great amount of household equipment. This points in the direction of a more modest part of Copenhagen with workshops and general everyday life of differing social status mostly reflected through the ceramic material.

This might also be confirmed by the finds of military objects like gambling pieces and plates with soldiers on (Fig. 30 and 31). This could indicate an area with a more concentrated presence of soldiers, which would be obvious in connection with the fortification being in the area, but soldiers were often quite poorly paid and would be in need of a not so expensive place to live. The finds of used musket balls and cannonballs in the Post medieval moat could indicate a somewhat unsteady area to live in at times.


Fig. 30. Early Post medieval, possibly German rapier. Quillon (FO501816). Photo: Museum of Copenhagen.

Fig. 31. Early Post medieval decorated bone plaque. Probably from a weapons handle (FO207364). Photo: Museum of Copenhagen.

# 10 Phase 1 Moraine, salt marshes and other Quaternary observations

## 10.1 Results

The Ice Age deposits in the Copenhagen area consist of two layers of moraine separated by transgression layers (Bahnson 1973a). The excavation area at Kongens Nytorv is placed on the transition between areas with respectively moraine and sand at the top of the sequence. Most of the excavation area consisted of subsoil of uniform transgression layers in places with a regular layering of thin layers of slightly coarser sand and in some places more compact layers of gravel and flint of different size. In the transition zone between the moraine and the transgression layers there were locally very irregular stratifications in the moraine that do not represent truncations, but may be due to processes associated with moving material or so-called cryoturbations. For further discussion and interpretation about flint artifacts from these layers; see Chapter 11.2.

As shown in the figure below the transgression layers and salt marshes are mainly registered in Lille Kongensgade, in connection with the fortification, where these layers have been protected by the medieval rampart, as well as in a wider area to the east outside the 17th century moat (Fig. 32 and Tab. 9).

The original coastal meadows were documented as a 0.2 m thick, dark layer on top of the natural sand and clay. The height is somewhat different – for the salt marshes these vary from kote +0.8 to +1.4 m above current sea level. Regarding the transgression layers, these are located between kote +0.6-2.0 m with the highest values to the north and outside Charlottenborg.

A salt marsh is an area of marshy ground that is intermittently inundated with salt water or that retains pools or rivulets of salt or brackish water, together with its characteristic halophytic vegetation. The salt marshes consisted of water deposited sand with very decomposed organic material with varying contents of plant parts, leaves, stems, roots and rhizomes, branches, buds, etc. where this represents a growth horizon formed in a moist, brackish or fresh environment occasionally flooded by the sea (cf. Steen Henriksen 1998:7-8). Limited cultural influences can be seen within these layers (mainly animal bones; SG-377) and no indications of human activity could be seen among the archaeobotanical material – but this is connected with the sampling and lack of further analysis.

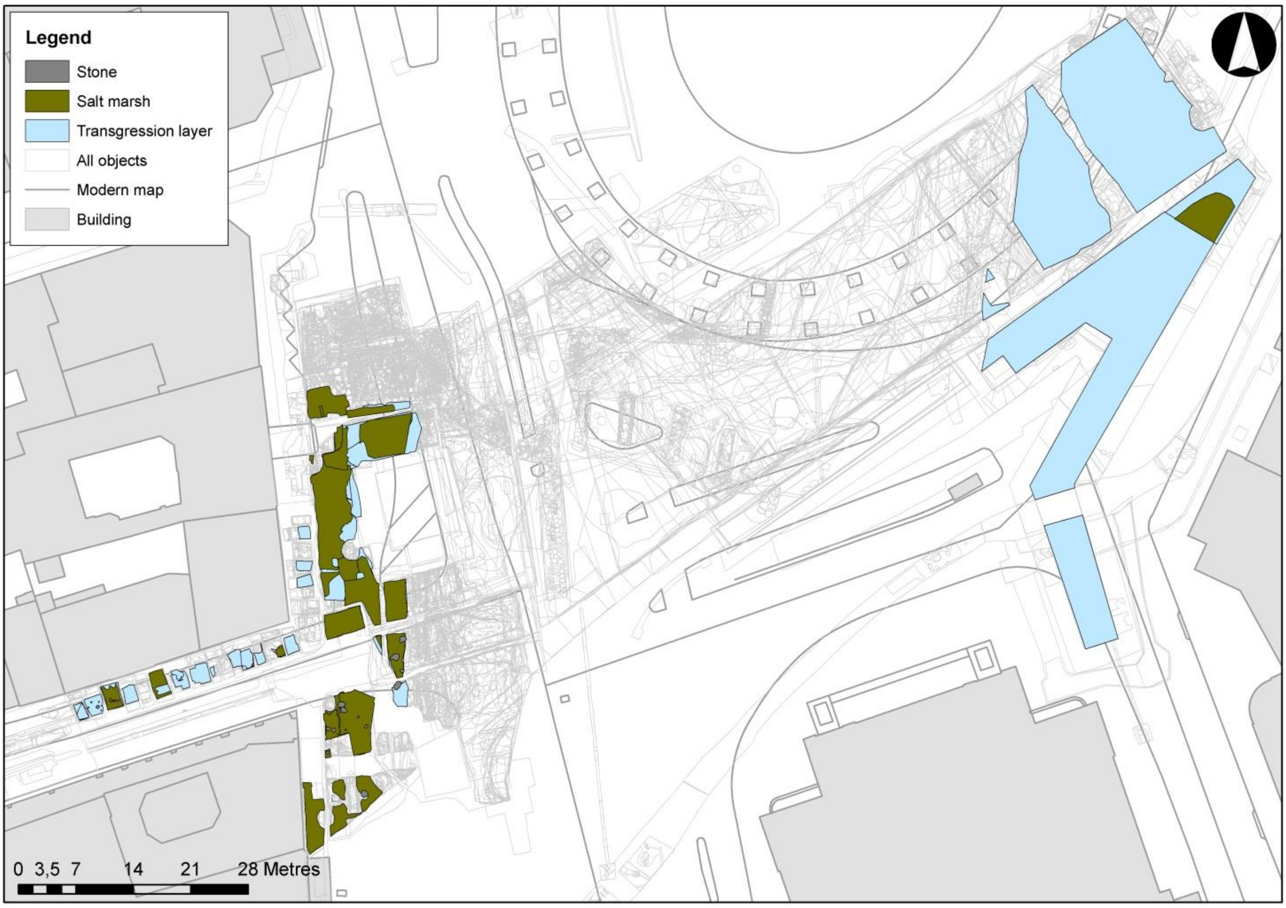


Fig. 32. Overview showing traces of transgression layers and salt marshes at Kongens Nytorv. The concentration of salt marshes in the western part is directly connected to the overlying and protecting rampart. The rest of the excavation area has been truncated by later activities, both historical and modern. In the watching brief trenches these natural layers were not measured due to limited depth and difficult survey conditions.

| Group | Type of feature | Subarea | Basic interpretation |
|---|---|---|---|
| 503046 | Layers, stones and imprints | Several phases | Transgression layers |
| 686 | Organic layers | Several phases | Salt marshes |

Tab. 9. Natural deposits and features at Kongens Nytorv.

## 10.2 Overall discussion and interpretation

A survey conducted for the Metro in 1996–1998 proved that the sub-surface consisted of glacial and late glacial deposits consisting of heterogeneous natural sand. Immediately over the moraine several layers of varying gravel, sand and mixed clay were recorded (Kristiansen 1998; 1999a).

Transgression at 4300 BC in the Copenhagen area has been estimated to lie between DVD90 kote +3.2 and +4.1 m (cf. Troels-Smith 1939; Digerfeldt 1975; Christensen 1981; 1995; Jacobsen 1982). During this transgression maximum, Copenhagen was divided by a narrow strait from Øresund that extended through the "Lake Valley" formed in the present location of Sortedamssøen, Peblingesøen and Skt. Jørgens' defensive reservoirs. This strait connected to Kalvebod Strand near the preset location of Vesterbro Torv in the south and near the present position of Frihavnen to the north. The paleo shoreline lay approximately where Kronprinsessegade is today. Refshaleholmen, Plantholm

(Mågeøen), Bremerholm, Strandholm (Slotsholmen), Skarnholmen and all other islets between Zealand and Amager were all covered by water (Christensen 1963:2-3).

According to estimations made by geologists and recent archaeological investigations the shoreline around 1000 AD is believed to have been going straight beside the contemporary Royal Theatre, northeast of Charlottenborg and then through the later Amalienborg area. It could not be excluded that the shoreline may have stretched to the north of Vingårdsstræde near Lille Kongensgade (cf. Rosenkjær 1906; Hartmann & Hartmann 1988:6; Fabricius 1999:App. 4, Fig. 33b and 266), but nothing in the main excavation area or nearby trenches supported such a suggestion (see also Fig. 32). Test drilling in Østergade No. 13 (Matr. No. 13) has also determined that the area was within the medieval coastline, but influenced by the previous Littorina Sea Transgression (Skaarup 2002; Sørensen 2002).

It must be pointed out that the marshy area in the low-lying landscape of Copenhagen would have been frequently flooded at high tide and during storm situations, which must have resulted in a varying shoreline.

Analyses of pollen and macrofossil samples suggest that the Copenhagen area during the 11th century was dominated by meadows with reed swamps. The coast, where Copenhagen was founded, was characterized by wet meadows. In the area where the medieval town came to be, between the Rådhuspladsen and Kongens Nytorv, the salt marshes must have been smallest. This environment in the upper coastal intertidal zone between land and salt or brackish water produced peat layers of varying thickness from 0.2 m to over 1.0 m, depending on local depressions, stream courses, etc. The coastal meadow has at several locations been documented as a 0.2 metres thick, dark stripe under deposit layers (Rosenkjær 1906:18 et seq.; Ramsing 1910; Christensen 1963:3 et seq.).

At the Metro investigations during 1996–1998 there were traces of this meadow vegetation in the southern part of the excavation area, which indicates that the area during part of the 13th century had been washed over by the sea. The boundary ditches and a wicker fence had been abandoned in the last decades of the 13th century, and then covered by the salt marshes. Pollen and macrofossil analysis has shown that this natural, dense reed swamp was with time changed to pasture land (Rosenkjær 1906; Kristiansen 1998; Moltsen og Steen Henriksen 1998; Boldsen 1996; 1998; Skaarup 1999:74 et seq.; El-Sharnouby and Høst-Madsen 2008:148).

No traces of the so-called “rallaget” (BRE-sequence) were identified during excavation (cf. Kristiansen 1998; Steen Henriksen 1998:8).

No further pollen analysis was conducted on the salt marsh layers, but the area has probably been used for grazing, where the most extensive settlements from the Iron Age, with some exceptions, mainly existed in the interior. This type of settlement localisation is also familiar from the other side of Øresund (cf. Björhem & Magnusson Staaf 2006:195 et seq.). However, AMS-dates from the Viking Age could represent fishing activities on a more seasonal basis (see Chapter 12.2.3; Clay lined pits).

# 11 Phase 2 Prehistoric finds and features

## 11.1 Results

Processed flint and bones were collected to enable dating and typing. Other organic material for possible future C14-analysis was also collected. In order to create a basis for a reconstruction of the local environment and changes in human activity at the site, all deposits created by nature and re-deposited layers were documented in the same way as other contexts.

Despite the occurrence of most flints in secondary contexts, the evidence points to the presence at Kongens Nytorv of a fragmented, near-shore settlement or “activity spot” dating to the Late Mesolithic and to the Neolithic.

Most of the material consists of non-diagnostic debitage. Notwithstanding these limitations, the assemblage affords important evidence of prehistoric settlement activity within the limits of Copenhagen. Also, patterns can be teased out of this material, which have chronological import and consequently corroborates inferences drawn on the basis of the formal tool types. The assemblage suggests that the majority of the finds derive from the later part of the Mesolithic (Ertebølle period), but Middle and Late Neolithic material is also present.

The assemblage consists of 113 flaked lithics from a variety of stratigraphic contexts and areas across the excavation. The principal findings of this study on the lithic material can be summarised in the following statements:

- A small amount of primary debitage.
- Few formal tool types.
- The presence of indirect percussion technique for blade production.
- A distinct lack of diagnostic Early Mesolithic components.
- It is possible to identify some of the flints as likely deriving from the coast by the presence of a marine affected cortex (white patinated) and indications of rolling.

There are 48 blades in the assemblage, of which 31 can be categorized as irregular blades. The remaining 17 regular blades are mostly plein débitage (i.e. prismatic blades with no cortex and transversal scars) struck with indirect percussion. They generally exhibit evidence of overhang removal and have distinct bulbs or bulbs and lips.

Examination of butts, impact rings, eraillure scars, bulbs and striking lips shows that almost all regular blades were struck off the core by indirect soft-hammer percussion, while most irregular blades and flakes were struck by direct percussion, most likely with a hammerstone. Hard-hammer direct percussion, used to detach blades from a core, results in generally thicker blades and is strongly associated with the Late Mesolithic Ertebølle period (Fig. 33), although some Ertebølle sites have a higher use of indirect soft-hammer technology.

Platform butts on both blades and flakes are with a few exceptions flat, but in 34 cases (of which 22 are blades) there is evidence of preparation of the front of the core, while such preparation was absent in 37 cases (seven were blades). Edge preparation work is done between striking off flakes or blades by gently tapping or rubbing the sharp, curving lip of the core platform with the hammer stone to trim it back. This technique was used to assure an exact blow was delivered to the striking area.

Fig. 33. Hard-hammer macroblade with usewear along both lateral edges (FO205902). Photo: Museum of Copenhagen.

Four flakes and one coarse blade (4.4%) have more than 50% cortex present, and can therefore be described as primary flakes, the first ones removed from corticated flint nodules. Thirty pieces had smaller amounts of cortex present (1-50%) The cortex was described as either “fresh” (n=12) or “worn” (n=21) and was in all cases thin (c. 1 mm).

Fifteen pieces displayed evidence of retouch or shaping, and included two flake scrapers, a Neolithic sickle blade and a polished Neolithic axe. In addition to these specific tool types there were also three truncated blades, one laterally retouched blade (FO213324) and five “miscellaneous retouch flakes“ (MRF), these are pieces that have retouch, but do not resemble any specific tool form. In total, 13.3% of the flint assemblage was attributed to a tool form or identified as an MRF.

A strike-a-light is made on a very thick blade of dark, grey Danien-type flint with flakes struck off from the distal end. Two or three broad, shallow flakes have been struck off (coincidentally?) from the blade’s steep sides. Six unretouched blades exhibit usewear and two of these have heavy usewear.

The most notable piece in the assemblage is a complete, Middle Neolithic thick-butted axe of the Lindø-type, dated 3000–2800 BC (FO202755) (Fig. 34). The sides of the axe are partially polished, except the third towards the neck.

The cutting edge is chipped and also appears rather dull in its present state. The axe is white-patinated but there are also areas where the patination is light grey. A few rust-spots can also be observed. It was found embedded in the natural sand subsoil and could have been lost on the former beach in the Neolithic. It is a quite common find in settlements of the period.


Fig. 34. Middle Neolithic thick-butted axe of Lindø-type (FO202755). Photo: Museum of Copenhagen.

A circular flake scraper (FO201169) is made with inverse, short retouch on what appears to be a blade core platform rejuvenation flake. The scars from detached blades and evidence of overhang trimming are clearly visible on the platform butt of the scraper. It is probably of Neolithic date. Another scraper is a flake end scraper with linear retouch on the distal end. There is also a flake with distal, oblique retouch and a flake with lateral retouch. A flake has some distal, steep retouch and a possible notch on one distal lateral. A retouched flake with linear, steep retouch is a possible scraper. Finally, there is a blade-like flake with lateral retouch.

Of special mention is a bifacial, crescent-shaped sickle with a high, arched back (FO205523). These are typical for the Late Neolithic period (2400–1800 BC), when there was a large-scale production of flint sickles of different forms. It was a tool type that remained in use until the end of the Early Bronze Age.

Unpatinated flints (n=35) exhibit a limited colour range, with shades or mixtures of grey and brown being the dominant colours. The remainder are a mixture of the above colours, with faint shades of yellow, green and blue included. There are two heat-affected lithics exhibiting colour change and hairline cracks. Burning probably occurred prior to deposition. A majority of the lithics (72%) have been subject to some degree of patination resulting in a distinctive, chalky white colour. While most are still sharp-edged, a few appear to have experienced rolling in a marine environment, which has smoothed and rounded their edges through erosion.

## 11.2 Overall discussion and interpretation

The Copenhagen area comprises a rich cultural landscape with traces of human activity and habitation dating back to 10 000 BC. The vast majority of these places are situated beyond the old city and stem from the Palaeolithic to the Bronze Age. Stone Age settlements, including submarine settlements from Kongemose culture are known at Frihavnen and beyond the coast of Amager. There are also Ertebølle settlements by Vedbæk, in Ordrup Mose, which was then a fjord, outside Kastrup at Amager, at Fredriksberggade and Fredriksholms quarters at Sydhavnen (Ramsing 1940, Vol. I:38 et seq.; Kjersgaard 1980:15; Christophersen 1985:12 et seq.). Some scattered archaeological evidence of prehistoric settlements is also to be found within the old city area. The occasional stray find has also been unearthed in this area.

Caused by the Littorina Sea's distribution the prerequisites for Neolithic remains are extremely limited. The Bronze and Iron Age elements are also few, and can be interpreted as destroyed graves (cf. Christophersen 1985:12 et seq.). The area around Utterslev, Brønshøjholm and Brønshøj is particularly rich in settlements and barrows. The clearest archaeological evidence of Iron Age settlements and graves is also to be found here.

Archaeological investigations of the oldest historical Copenhagen have for many years held a naturally dominant position among archaeologists working within the city. In contrast, the study and observations of the city's prehistoric finds have been left significantly in the background. The discovery of a flint arrowhead from Rigshospitalet (the National Hospital) testifies to the fact that people have frequented the area for more than 12 000 years, but actual settlements seem to appear only from the later part of the Mesolithic period nearly 8 000 years ago with the finds from Frihavnen occupying a prominent position (cf. Rosenkjær 1893, 1896; Andersen 1985).

Notwithstanding these limitations, the assemblage affords important evidence of prehistoric settlement activity within the limits of Copenhagen. Also, patterns can be teased out of this material, which have chronological import and consequently corroborates inferences drawn on the basis of the formal tool types.

### 11.2.1 Stone Age finds from central Copenhagen

In 1928 an article appeared with the first full description of finds from the prehistoric period in Copenhagen, Under Asfalt og Brostene, in which Kjær summarized the state of research at the time (Kjær 1928). In 1939, Troels-Smith discussed in some detail a number of Mesolithic sites on Amager and their relationship to shoreline displacement (Troels-Smith 1939). The following year, Ramsing could refer in his three-volume work Københavns Historie og Topografi to the new discovery of a worked antler from Middlegrunden, which for many years was considered the oldest find in Copenhagen (Ramsing 1940, Vol I:38 et seq.). Ramsing's works continued to be central for an understanding of the city's prehistoric development and it is only in 1985 that Knud Andersen threw new light on the findings from Frihavnen (Andersen 1985:42 et seq.). The investigation – and subsequent fieldwork in 1991–1992 showed that there had been at least two settlements from the second half of the Mesolithic period. In 2004, trial excavations at Amager Strandpark revealed remains of a large Mesolithic settlement (Dencker 2006). Most recently Stensager has summarized the current state of knowledge regarding Mesolithic finds in Copenhagen (Stensager 2004).

More than 110 Stone Age find spots are currently known in the municipality of Copenhagen of which around 30 are find spots in the central part of the city. While most are single finds, there seems to be at least one Ertebølle locality at Nytorv/Frederiksberggade, 550 m SW of Kongens Nytorv (Københavns Sogn, Sokkelund Herred, Københavns Amt, SB nr. 14). In 1907, a blade core and two blades were found here at a depth of app. 3.7 metres. In connection with archaeological excavations of the old town hall (also Nytorv) by Chr. Axel Jensen in 1937, 71 pieces of flint were collected, mainly larger blades and flakes and an edge flake from a core axe. Unfortunately, finds information is sparse and it is likely that the flints were merely casually collected during the course of the excavation. The existence of a settlement site at Nytorv was confirmed after the construction of bunkers just opposite the court house in 1944. On this occasion, 88 blades and flakes were retrieved. Although none of these works documented the exact position and context of the finds, there is little doubt that a settlement site was located on the beach under and around the later town hall. The flints are reported as patinated. The flints would be part of a larger complex which was lost in connection with the many conversions of the square. Other assumed settlement remains from central Copenhagen (the medieval parts) involving lithics have been retrieved at Amaliegade 13, Farvergade 15, Gammeltorvs Apotek, Kattesundet and Slotsholmen (Kjær 1928, 112-113; Stensager 2004). Outside central Copenhagen, a significant assemblage from the Ertebølle period and the Neolithic period has been found at Frederiksholms Teglværk in Sydhavnen (Larsen 1947). The Ertebølle flint was white-patinated while this was not the case for the Neolithic material (Stensager 2004:4).

### 11.2.2 A Late Mesolithic "activity spot" or camp site at Kongens Nytorv

Although it is not anticipated that there are significant remains of prehistoric date at Kongens Nytorv, there are low levels of activity in the form of residual artefacts. There may also be evidence of occupation as the site lies in an area surrounded by wetlands/marshlands. Locations similar to these can be places of preferential activity during the prehistoric period as they provide ample resources for hunting, fishing and foraging. Such satellite locations are well known from Mesolithic contexts previously.

The lack of a distinct Early Mesolithic component, such as microblades, microblade cores, microburins and microliths, suggests that most or all of the assemblage from Kongens Nytorv perhaps should be dated to the later part of the Mesolithic and to the Middle and Late Neolithic. Finds of flint tools and debitage have indeed shown that current central Copenhagen was visited or lived on, on several occasions during the Stone Age. The first visitors may have arrived in the area from around 6000 BC as attested, for instance, by the find of a rhomboid core axe from Fredericiagade, transverse arrowheads from Rådhuspladsen and the finds from Frihavnen. How the findings should be interpreted, we can only guess. Many recovered flints are stray finds and there is often uncertainty about the circumstances in which they have been found. This is the reason why potential settlement indicators, as fragmented as the material may be, are so significant when found within the urban environment.

Based on the current evidence, it seems certain that hunters moved along the former Øresund coastline and perhaps stayed at small settlements for short periods to extract food and other resources from the coastal environment, and to knap flint. Late Mesolithic find spots show a maritime preference both in terms of elevation and location for near-shore locations. Early and Later Neolithic find spots are located in the same areas, but generally these sites are found at higher elevations and more inland in relation to the coastline.

The displacement of the coastline became an important aspect of life during the Late Mesolithic and would also have affected the locality at Kongens Nytorv. It is unclear whether the flint was deposited in a settlement area with a subsequent light rearrangement during a sea level rise or whether the flint was transported within sediment transfers to Kongens Nytorv from a different location. A few lithics from the excavation have been found in geological layers, with one identified as a "transgression layer" (SD93752). Lithics from these contexts are clearly patinated, which lends support to the suggestion that at least some, if not most, lithics were originally deposited around Kongens Nytorv, despite the fact that many of the lithics later were redeposited into secondary contexts. There are no discernible differences in form and technology between the patinated and unpatinated flints. While no evidence of actual habitation sites belonging to the Mesolithic have been found in the area, the flints' marine-affected patina points to an origin within the zone affected by the sea level rise. The current evidence therefore seems to support the hypothesis that a Late Mesolithic "activity spot" or camp site proper at Kongens Nytorv was inundated and disturbed on one or several occasions by marine transgression (cf. Christensen 1995:15 et seq.).

The Neolithic site's location in the beach zone along with the lack of burnt flint or charcoal argues that the activities do not represent a main settlement and the vast majority of the worked flint belongs to this activity.