

NEH Application Cover Sheet (FA-252561)

Fellowships for University Teachers

PROJECT DIRECTOR

Dr. Federico Buccellati

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Field of expertise: Archaeology

INSTITUTION

The Alexandria Archive Institute

San Francisco, CA 94127

APPLICATION INFORMATION

Title: *A Web-Based Energetics Calculator for Ancient Architecture*

Grant period: From 2017-01-02 to 2017-12-31

Project field(s): Archaeology

Description of project: Architecture is one of the main elements of material culture that archaeologists find in the archaeological record. One of the most important aspects of architecture is the process of construction leading up to the first use of the building. Cost-calculation-algorithms can be applied to the volumes of ancient architecture to explore the temporal, material or energetic ‘cost’ of the steps of that process. Up to now this has been done on an ad-hoc basis, with scholars finding appropriate comparisons. This project will produce an interactive interface where scholars enter volumetric data from their research. The algorithms draw from a wide variety of sources from across diverse cultural spheres. The final result will be a web-based interface published on GitHub so that future scholars can add to the algorithms and sources.

REFERENCE LETTERS

Eric Kansa

Technology Dir. & Open Context Program Dir.

The Alexandria Archive Institute

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Jan-Waalke Meyer

Professor Emeritus

Near Eastern Archaeology

University of Frankfurt - Frankfurt, Germany

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NEH Supplemental Information for Individuals

This form should be used by applicants to the NEH Fellowships, Fellowships for Advanced Social Science Research on Japan, Awards for Faculty, and Summer Stipends Programs.

Field of Project:

Field of Project #2:

Field of Project #3:

Project Director Field of Study:

The mailing address provided on the SF 424-Individual is for your work home

Institutional Affiliation

Are you affiliated with an institution? (If yes, provide information below.) Yes No

Institution Name:

Street 1:

Street 2:

City:

County:

State:

Province:

Country:

Zip / Postal Code:

DUNS Number:

Employer/Taxpayer Identification Number (EIN/TIN):

Status: Senior Scholar Junior Scholar

Reference Letters

Reference 1

First Name:

Last Name:

Email:

Title:

Department Name:

Institution:

Reference 2

First Name:

Last Name:

Email:

Title:

Department Name:

Institution:

Nominating Official (Summer Stipends Applicants Only)

Are you exempt from nomination? If not, provide information below. Yes No

First Name:

Last Name:

Email:

Title:

Institution:

A Web-Based Energetics Calculator for Ancient Architecture

Federico Buccellati – NEH-Mellon 2016 Grant Proposal

1. Narrative portion

Research and contribution

Architecture is one of the main elements of material culture that archaeologists find in the archaeological record. The main focus is generally on the typology of the building, the function of the spaces and the life of the building as shown in the stratigraphy. There is, however, another important aspect which is seldom explored: the process of construction leading up to the first use of the building.

The chaîne opératoire methodology permits one to explore this process, allowing for its disarticulation into discrete steps. It cannot, however, explore the temporal, material or energetic ‘cost’ of these steps – cost-calculation-algorithms are needed which can be applied to the volumes of ancient architecture.

These algorithms attempt to answer specific questions regarding the cost (in time, material and/or energy) needed for the steps in the construction process on the basis of the actual (as present in the archaeological record) or estimated volumes of the building. Consider a mudbrick building: how many mudbricks were needed to build the walls? How much soil and straw were needed to produce those mudbricks? How many man-hours were needed to produce those bricks? How much mortar would have been needed? How many roof beams? If there are stone foundations or flagstone paving, where did this stone come from and how were they quarried? How many man-days would it have taken to cut the stone and transport it?

An example: David Oates calculated that for 100 bricks approximately 1 ½ sacks of chaff were needed, about 60kg (D. Oates 1990, 390). About 1/8 of a hectare was needed to produce 1 ½ bags of chaff (D. Oates 1990), giving the parameters for a rough estimate of the agricultural area needed to provide for a known number of bricks.

The sources for these algorithms can be placed in three categories: ethnographic observation, experimental archaeology, and textual sources. Ethnographic observations include research done by scholars (primarily anthropologists) looking at modern work situations. These observations establish a relationship between the variables being considered (materials used, end product, workforce required and the time needed for tasks) that are common to the culture in which they are working, and come from a wide range of geographic regions and chronological periods.

The second category of sources, those deriving from experimental archaeology, is similar to ethnographic observations but for one aspect: the process being studied is not part of the activities normally carried out, but rather attempts to re-create elements of material culture found in the archaeological record. The distinction is important, as the data derived from experimental archaeology is based on the archaeologist’s re-creation of an otherwise undocumented process which took place in the past. This re-creation is normally derived from information obtained from local informants who may know and work with the materials already, albeit in another form.

The third group of algorithms comes from textual sources. These are normally ancient administrative texts which describe numbers of people employed in construction – the tasks of these workers are also often listed. From these texts we can derive algorithms that include the variables under consideration for a specific process: materials used, end product, workforce required and time needed.

Such analyses can be applied to structures in any pre-industrial society, and, because of

their nature, cross-cultural comparisons can be as meaningful as intra-cultural studies. The understanding arrived at through these algorithms allow scholars to understand not only the practical side of construction but also to look into questions regarding the community. The amount of straw needed, for example, can give an indication of how much surplus straw would have been available. The decision to use more 'costly' flagstones for paving, instead of brick or beaten-earth floors, leads to considerations of prestige and monumentality. Such questions can be asked of any building in any pre-industrial society, and, in some cases comparing the results across cultures can give meaningful correlations.

This project allows scholars to study the process of construction for the buildings that they are working on based on the algorithms described above. It collects the many sources from which algorithms can be derived, and codifies them in a web interface so that scholars can quickly calculate the temporal, material and energetic 'costs' that ancient builders would have had.

Methods and workplan

The methodology has been used by the applicant during previous research on the 3rd millennium BC Palace at Tell Mozan, ancient Urkesh, a site in the Northeastern corner of what is today Syria. A range of algorithms pertinent to that structure were developed and used to define the cost of construction for that edifice, and lead to a discussion of value in relation to monumentality and prestige (Buccellati forthcoming). A forthcoming article written with E. Kansa demonstrated the applicability of the algorithms to buildings from other cultural contexts, and showed the utility of Open Context data to go beyond a single case study (Buccellati and Kansa forthcoming).

What is needed now is a platform where the algorithms are presented in an interactive interface, linked via scholarly references to the sources from which they were derived and examples for comparison. Such an interface will allow scholars working with architecture to use their own data to calculate the temporal, material or energetic costs of buildings on which they are working. To produce this interface a much wider range of data is needed to create algorithms which can be applied outside of Near Eastern Archaeology. These data would be derived from all three sources listed above: ethnographic observation, experimental archaeology, and textual sources, and would come from work done in the Egyptian, Mediterranean, African, Central Asian, Oriental and Northern, Central and Southern American cultural spheres. This would produce not only new algorithms for materials not yet documented in the work cited above, but would also confirm (or bring into question) these algorithms based on different source material or coming from another cultural sphere. These modular cost-calculation-algorithms also enable the exploration of diverse choices made in construction, for example determining the 'cost' of constructed spaces in diverse materials.

The work plan for the project would include three stages: an initial stage to expand the number of sources and algorithms, a coding period, and finally a testing and examples period. The first step would be to expand the number of algorithms by looking for a wide spectrum of sources from anthropological, archaeological and engineering texts. This will require 5 months, as the sources come from a wide range of scholarly disciplines and the information needed is often embedded in excavation or research reports.

The coding period would require 3 months, during which the algorithms would be embedded in an interactive form allowing users to enter volumes of constructed space (walls, roofs, etc.) or quantities of construction materials (number of bricks, bags of straw) and obtain answers regarding raw materials or man-hours needed. Each algorithm would have an explanation as well as links to other relevant algorithms; the documentation for each single algorithm would be

provided, linking directly to the text (for example on JSTOR) when possible.

The last period would be dedicated to the testing of the algorithms using examples from a wide spectrum of buildings from diverse time periods and using many different types of construction materials. These examples would then become part of the interactive form, allowing users to compare their entered data to intra- or inter-cultural examples already calculated. A complete user's manual would be produced, giving an introduction to the project as a whole and describing in detail the methods and sources used. This final period would cover the last 4 months of the grant, for a total of 12 months.

Competencies, skills and access

The applicant's PhD thesis, entitled "Three-dimensional Volumetric Analysis in an Archaeological Context: The Palace of Tupkish at Urkesh and its Representation" (soon to be published with Undena Books in its UMS series) was awarded "Summa Cum Laude" from the University of Frankfurt (Frankfurt am Main, Germany). A portion of the dissertation used a series of algorithms to calculate the temporal, material and energetic cost of the AP Palace at Tell Mozan, an Akkadian palace dating to ca. 2300 BC. Further publications include the article written together with E. Kansa mentioned above, and an article due to come out in *Studia Eblaitica 2* concerning the heuristic potential of 3D models which includes a discussion of algorithms and CAD-generated volumetric measurements (Buccellati forthcoming).

The research will be conducted in California, where the applicant is a resident, as well as in Berlin, Germany. The Alexandria Archive Institute, the host institution, is located in San Francisco. The Alexandria Archive "runs Open Context, a digital library-backed system for Web-based publication of research data. Open Context enables publication, access, and reuse of editorially-reviewed data and media from archaeology and related disciplines." (from the alexandriarchive.org website) Open Context provides archaeological examples from across the world, and the collaboration with the Alexandria Archive and the data in Open Context will be invaluable for the success of this project. The TOPOI project in Berlin, Germany is an interdisciplinary research cluster with sections dealing with monumental architecture as well as construction techniques (particularly Research Area B: Constructing Historical Space). The research materials needed are publications relating to the sources mentioned above – these can be found in the Library system of the University of California and the libraries in Berlin: Staatsbibliothek, the FU library, the Humboldt library and the TOPOI research library.

The applicant is fluent in Italian and German and has reading ability in French and Spanish. These languages will be needed for the research proposed here as many of the sources mentioned above are published in these languages. In terms of computing skills necessary for this project, the applicant has worked with HTML 5, Java, MS Visual Basic, and GitHub.

Final product and dissemination

The web interface proposed here would be published as an interactive website. The code behind the interface would be published as an open source document with GitHub, allowing for changes to be made by future scholars as more information and sources become available. By making these cost-calculation algorithms and their source background open-source, we make parameters explicit, reusable and contestable. The audience for the interface is made up of scholars working on ancient architecture – and as the project data will be made open source, as long as these scholars also contribute to the underlying algorithms and data then the interface will be of use to scholars far into the future.

2. Bibliography

- Abrams, E. 1994. *How the Maya Built Their World: Energetics and Ancient Architecture*. Austin, TX: University of Texas Press.
- Aurenche, O. 1981. *La maison orientale : l'architecture du Proche Orient ancien des origines au milieu du quatrième millénaire*. Paris: P. Geuthner.
- Buccellati, F. forthcoming. "3D Models as Vehicles for Archaeological Research: Stratigraphy, Emplacement and Construction." *Studia Eblaitica* 2.
- . forthcoming. *Three-Dimensional Volumetric Analysis in an Archaeological Context: The Palace of Tupkish at Urkesh and Its Representation*. Vol. UMSX 15. Bibliotheca Mesopotamica. Malibu, CA: Undena Publications.
- Buccellati, F., and E. Kansa. forthcoming. "The Value of Energetic Analysis in Architecture as an Example for Data Sharing." *Digital Applications in Archaeology and Cultural Heritage*.
- Butterlin, P. 2006. "Où Sont Les Fenêtres? Lumière et Architecture Tripartite Proto-Urbaine de Haute Mésopotamie." In *Les Espaces Syro-Mésopotamiens: Dimensions de L'expérience Humaine Au Proche-Orient Ancien: Volume D'hommage Offert À Jean-Claude Margueron*, by P. Butterlin and J.-C. Margueron, 17:41. Turnhout: Brepols.
- Clark, D. 2003. "Bricks, Sweat and Tears: The Human Investment in Constructing a 'Four-Room' House." *Near Eastern Archaeology* 66 (1/2): 34–43.
- Coles, J. 1974. *Archaeology by Experiment*. New York: Scribner.
- Cornerstones Community Partnerships. 2006. *Adobe Conservation: A Preservation Handbook*. Santa Fe, NM: Sunstone Press.
- Devolder, M. 2009. "Hâte-toi de bâtir la demeure, hâte-toi d'édifier le palais." *Creta Antica* 6: 165–86.
- Doat, P. 1979. *Construire en terre*. Paris: Alternatives et Parallèles.
- Fitzsimons, R. 2011. "Monumental Architecture and the Construction of the Mycenaean State." In *State Formation in Italy and Greece: Questioning the Neoevolutionist Paradigm*, edited by N. Terrenato and D.C. Haggis, 75–118.
- Harrell, J. 2008. "Tools Used in Ancient Egyptian Construction." *Encyclopaedia of the History of Science, Technology, and Medicine in Non-Western Cultures*. Berlin, New York: Springer.
- Heimpel, W. 2009. *Workers and Construction Work at Garshana*. CUSAS 5. Bethesda, MD: CDL Press.
- Heinrich, E. 1934. *Schilf und Lehm: Ein Beitrag zur Baugeschichte der Sumerer*. Berlin: Verlag für Kunstwissenschaft.
- Klemm, R. 1993. *Stein und Steinbrüche im alten Ägypten*. Berlin; New York: Springer.
- Kurapkat, D. 2009. "Das Wissen der neolithischen Bauleute." In *Bautechnik im antiken und vorantiken Kleinasien*. Vol. 9. BYZAS. Istanbul: Ege Yayınları.
- Margueron, J.-C. 1982. *Recherches sur les palais mésopotamiens de l'Age du bronze*. Paris: Geuthner.
- Moorey, P. 1999. *Ancient Mesopotamian Materials and Industries : The Archaeological Evidence P.R.S. Moorey*. Winona Lake Indiana: Eisenbrauns.
- Morgenstein, Maury E., and Carol A. Redmount. 1998. "Mudbrick Typology, Sources, and Sedimentological Composition: A Case Study from Tell El-Muqdam, Egyptian Delta." *Journal of the American Research Center in Egypt* 35: 129–46.
- Nemet-Nejat, K.R. 1993. *Cuneiform Mathematical Texts As a Reflection of Everyday Life in Mesopotamia*. New Haven, CN: American Oriental Society.
- Oates, D. 1990. "Innovations in Mud-Brick: Decorative and Structural Techniques in Ancient Mesopotamia." *World Archaeology* 21 (3): 388–406.
- Protzen, J.-P. 1985. "Inca Quarrying and Stonecutting." *Journal of the Society of Architectural Historians* 44 (2): 161–82.
- Salonen, A. 1972. *Die Ziegeleien im alten Mesopotamien*. Helsinki: Academia Scientiarum Fennica.
- Sauvage, M. 1998. *La brique et sa mise en oeuvre en Mésopotamie: des origines à l'époque Achéménide*. Paris: Éd. Recherche sur les Civilisations.
- Smith, C.B. 2006. *How the Great Pyramid Was Built*. New York, NY: Harper Paperbacks.

3. Résumé

Current Position

Post-doc Fellow – Art Histories and Aesthetic Practices (October 2015 – July 2016)

Transcultural Forum / Max-Planck-Institut – Kunsthistorisches Institut in Florenz (Berlin, Germany)

Post Doctoral Fellowship within the Transcultural Forum;

Workplace: Vorderasiatisches Museum – Pergamon Museum, Berlin.

Research title: “Mesopotamian Palatial Architecture: A Study of Space and Authorship”.

Education

2007 – 2014: PhD with “Summa cum Laude”, Goethe Universität, Frankfurt a.M., Germany

Title of dissertation: Three-dimensional Volumetric Analysis in an Archaeological Context: The Palace of Tupkish at Urkesh and its Representation. Readers: Prof. Dr. Jan-Waalke Meyer (Frankfurt am Main, Germany), Prof. Dr. Pascal Butterlin (Paris I, France) and Prof. Dr. Dittmar Machule (TU Hamburg-Harburg, Germany).

2/6-9-2012: Summer School, *Fraunhofer Institute IGD* – Darmstadt Schmittchen (Hessen), Germany

Participated in the German V-MUST Summer School, which presented cutting edge technology developed at the Fraunhofer Institute to academics and professionals involved in cultural heritage.

2000 – 2006: MAGISTER: NEAR EASTERN ARCHAEOLOGY *Eberhard-Karls Universität, Tübingen, Germany*.

Supervisor: Prof. Dr. P. Pfälzner. Degree with two Majors: Near Eastern Studies and Philosophy.

1995 – 1999: Bachelor of Arts, *St. John’s College Annapolis, MD, USA*

BA from the “Great Books” college, focusing on Philosophy, History of Science and History of Mathematics.

Grants & Fellowships

March 2014 – February 2015: Förderlinie A – *Goethe Universität Frankfurt a.M., Germany*

A seed grant from the Goethe University for initial research into changes in material culture between the Mittani and Middle Assyrian periods. The research question focuses on material culture as a mechanism and indicator of control between these two very different political powers.

JULY 2013 – DECEMBER 2013: Nachwuchsförderung (Post-Doc), *Goethe Universität Frankfurt a.M., Germany*

A Post-Doc from the Graduiertenkolleg “Wert und Equivalent” (Research Training Group “Value and Equivalence”) sponsored by the DFG (Deutsche Forschungsgemeinschaft) as Graduiertenkolleg 1576. The PostDoc was given for the elaboration of a database scheme for the study of glyptics. Grant was awarded upon the submission of the thesis for evaluation in June 2013.

2007 – 2014: *Goethe Universität Frankfurt a.M., Germany*

PhD associate status & scholarship holder from the Research Training Group “Value and Equivalence” (DFG 1576).

Publications

Monograph:

F. Buccellati. Forthcoming. *Three-dimensional Volumetric Analysis in an Archaeological Context: The Palace of Tupkish at Urkesh and its Representation*. UMS series volume 15. Undena Publications.

Edited Volume:

F. Buccellati, T. Helms & A. Tamm eds. 2014. *House and Household Economies in 3rd Millennium B.C.E. Syro-Mesopotamia*. BAR International Series 2682.

Articles and Book Chapters:

F. Buccellati. Submitted for review. “3D Models as Vehicles for Archaeological Research: Stratigraphy, Emplacement and Construction”, *Studia Eblaitica* 2.

F. Buccellati, E. Kansa. Submitted for review. “The Value of Energetic Analysis in Architecture as an Example for Data Sharing.”, *Digital Applications in Archaeology and Cultural Heritage (DAACH)*.

- F. Buccellati. 2015. "What Might a Field Archaeologist Want from an Architectural 3D Model?" in *How Do We Want the Past to Be?: On Methods and Instruments of Visualizing the Ancient Reality*. M.G. Micale, and D. Nadali eds. Gorgias Press. Pp. 157-169.
- F. Buccellati. 2014. "Understanding Households – a few thoughts" in *House and Household Economies in 3rd Millennium B.C.E. Syro-Mesopotamia*, F. Buccellati et al. (eds). BAR International Series 2682. Pp. 35-42.
- F. Buccellati. 2014. "Diachronic Developments at the Central Monumental Complex of Ancient Urkesh (Tell Mozan)" in *Proceedings of the 8th ICAANE, Warsaw, 30th April - 3rd May 2012*. P. Bielinski et al. (eds). Wiesbaden: Harrassowitz Verlag. Pp. 150-158.
- F. Buccellati. 2012. "Wie wird ein Palast gebaut und warum?" in *Werte im Widerstreit. Von Bräuten, Muscheln, Geld und Kupfer. Ausstellungskatalog Wiesbaden*. P. Breunig & C. Trümpler (eds). Frankfurt am Main. Pp. 31-34.
- F. Buccellati. 2010. "The Monumental Temple Terrace at Urkesh and its Setting" in *Kulturlandschaft Syrien – Zentrum und Peripherie – Festschrift fuer Jan-Waalke Meyer*. (=AOAT 371). J. Becker, R. Hempelmann, and E. Rehm (eds). Muenster: Ugarit Verlag. Pp. 71-85.
- F. Buccellati, N. Dell'Unto, and M. Forte. 2005. "The Tell Mozan/Urkesh Archaeological Project: an Integrated Approach of Spatial Technologies". In *The Reconstruction of Archaeological Landscapes through Digital Technologies*, Maurizio Forte ed. Oxford: BAR International, Pp. 171-183.
- F. Buccellati. 2001. "Digital Photography and Architectural Modeling as Elements of Conservation". In *Gli Opifici di Urkesh*. In Mozan – Urkesh Studies 4, Bibliotheca Mesopotamica 27. S. Bonetti (ed.). Malibu: Undena Publications. Pp. 83-88.
- F. Buccellati. 1998. "3D Rendering and Animation at Tell Mozan/Urkesh". In *Urkesh and the Hurrians: Studies in honor of Lloyd Cotsen*, G. Buccellati and M. Kelly-Buccellati (eds). Mozan – Urkesh Studies 3, Bibliotheca Mesopotamica 26. Malibu: Undena Publications. Pp. 53-62.

Positions Held

- 2008-Current: ASSISTANT DIRECTOR for IIMAS (International Institute for Mesopotamian Area Studies)
 2010-Current: ASSISTANT DIRECTOR, Mozan/Urkesh Archaeological Project
 2008-2010: FIELD DIRECTOR, Mozan/Urkesh Archaeological Project
 1997-2000: COMPUTER GRAPHICS TECHNICIAN, IIMAS: Built and animated 3-D computer model of AK Palace of Urkesh for documentary produced by TSI, Swiss Television – English and Italian language.
 2009: COORDINATOR for the Mozan/Urkesh Archaeological Project within the ARCANE Project, RG8

Teaching

- LECTURER, *Universität Frankfurt (Main)* –
Upper Level Seminar (Hauptseminar):
 SS 2015: Perspektive Archäologischer Interpretation/Archaeological Theory
 WS 2013-14: Darstellungsweise der Architektur – von der Theorie bis zum 3D-Modell/Perception of Architecture
 WS 2008-09: Perspektive Archäologischer Interpretation/Archaeological Theory
Concentrated Seminar (Blockseminar):
 SS 2011: Paläste in der mesopotamischen Frühzeit/Palaces in 3rd Millennium Greater Mesopotamia
Introductory Seminar (Proseminar):
 SS 2010: Die Archäologie und das Internet/Introductory class on archaeological research and publishing online



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Re: Letter of Support for Federico Buccellati

May 18, 2016

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(b) (6)

A handwritten signature in black ink, appearing to read "Eric C. Kansa". The signature is fluid and cursive, with a long horizontal stroke at the end.

Eric C. Kansa, PhD.

Program Director, Open Context (<http://opencontext.org>)

Researcher, UC Berkeley, D-Lab (<http://dlab.berkeley.edu/people/eric-kansa>)

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31. May 2016

Reference Letter for Federico Buccellati

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[Redacted content]

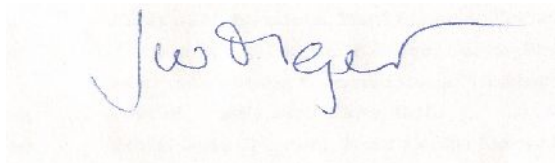
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(Prof. Dr. Jan-Waalke Meyer)