MUHANDISLIK & IQTISODIYOT

ijtimoly-igtisodiy, innovatsion texnik, fan va ta'limga oid ilmiy-amally jurnal

2026-YIL

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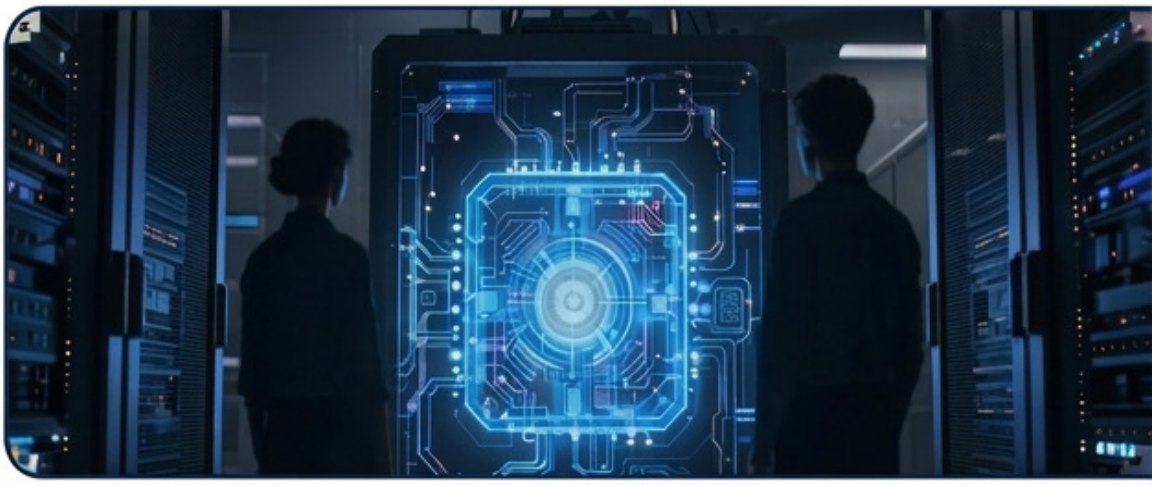
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05.01.00 – Axborot texnologiyalari, boshqaruv va kompyuter grafikasi
05.01.01 – Muhandislik geometriyasi va kompyuter grafikasi. Audio va video texnologiyalari
05.01.02 – Tizimli tahlil, boshqaruv va axborotni qayta ishlash
05.01.03 – Informatikaning nazariy asoslari
05.01.04 – Hisoblash mashinalari, majmualari va kompyuter tarmoqlarining matematik va dasturiy ta'minoti
05.01.05 – Axborotlarni himoyalash usullari va tizimlari. Axborot xavfsizligi
05.01.06 – Hisoblash texnikasi va boshqaruv tizimlarining elementlari va qurilmalari
05.01.07 – Matematik modellashtirish
05.01.11 – Raqamli texnologiyalar va sun'iy intellekt
05.02.00 – Mashinasozlik va mashinashunoslik
05.02.08 – Yer usti majmualari va uchish apparatlari
05.03.02 – Metrologiya va metrologiya ta'minoti
05.04.01 – Telekommunikasiya va kompyuter tizimlari, telekommunikasiya tarmoqlari va qurilmalari. Axborotlarni taqsimlash
05.05.03 – Yorug'lik texnikasi. Maxsus yoritish texnologiyasi
05.05.05 – Issiqlik texnikasining nazariy asoslari
05.05.06 – Qayta tiklanadigan energiya turlari asosidagi energiya qurilmalari
05.06.01 – To'qimachilik va yengil sanoat ishlab chiqarishlari materialshunosligi
05.08.03 – Temir yo'l transportini ishlatish
05.08.06 – "G'ildirakli va gusenisali mashinalar va ularni ishlatish" (texnika fanlari)
05.09.01 – Qurilish konstruksiyalari, bino va inshootlar
05.09.04 – Suv ta'minoti. Kanalizatsiya. Suv havzalarini muhofazalovchi qurilish tizimlari
10.00.06 – Qiyosiy adabiyotshunoslik, chog'ishtirma tilshunoslik va tarjimashunoslik
10.00.04 – Yevropa, Amerika va Avstraliya xalqlari tili va adabiyoti
08.00.01 – Iqtisodiyot nazariyasi
08.00.02 – Makroiqtisodiyot
08.00.03 – Sanoat iqtisodiyoti
08.00.04 – Qishloq xo'jaligi iqtisodiyoti
08.00.05 – Xizmat ko'rsatish tarmoqlari iqtisodiyoti
08.00.06 – Ekonometrika va statistika
08.00.07 – Moliya, pul muomalasi va kredit
08.00.08 – Buxgalteriya hisobi, iqtisodiy tahlil va audit
08.00.09 – Jahon iqtisodiyoti
08.00.10 – Demografiya. Mehnat iqtisodiyoti
08.00.11 – Marketing
08.00.12 – Mintaqaviy iqtisodiyot
08.00.13 – Menejment
08.00.14 – Iqtisodiyotda axborot tizimlari va texnologiyalari
08.00.15 – Tadbirkorlik va kichik biznes iqtisodiyoti
08.00.16 – Raqamli iqtisodiyot va xalqaro raqamli integratsiya
08.00.17 – Turizm va mehmonxona faoliyati

Ma'lumot uchun, OAK Rayosatining 2024-yil 28-avgustdagi 360/5-son qarori bilan "Dissertatsiyalar asosiy ilmiy natijalarini chop etishga tavsiya etilgan milliy ilmiy nashrlar ro'yxati"ga texnika va iqtisodiyot fanlari bo'yicha "Muhandislik va iqtisodiyot" jurnali ro'yxatga kiritilgan.

Muassis: "Tadbirkor va ishbilarmon" MChJ
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SEISMIC ASSESSMENT OF HISTORIC MASONRY WITH SOIL–STRUCTURE INTERACTION: A SCOPUS BIBLIOMETRIC ANALYSIS (2010–MARCH 2025)

Naimaxon Musoxonovna Nasrullayeva
Master's Student, Turin University

Annotatsiya. Zilzilaga moyil hududlarda joylashgan tarixiy g'isht-tosh konstruksiyali yodgorliklarni baholashda konstruktiv zaiflik bilan bir qatorda poydevorlar va mahalliy grunt sharoitlarining ta'sirini ham kompleks hisobga olish talab etiladi. Tadqiqotda tarixiy g'isht-tosh konstruksiyalar, seysmik baholash va grunt–inshoot o'zaro ta'siri (SSI) yo'nalishlari kesishmasida Scopus bazasida indekslangan ilmiy tadqiqotlarning rivojlanish tendensiyalari bibliometrik jihatdan tahlil qilindi. Bibliometrik ma'lumotlar 2025-yil mart oyida Scopus bazasidan tarixiy va madaniy meros obyektlarining g'isht-tosh konstruksiyalari, zilzila muhandisligi, seysmik mustahkamlash, grunt–poydevor–inshoot o'zaro ta'siri, hududning seysmik reaksiyasi hamda geotexnik xususiyatlarga oid atamalarni birlashtiruvchi strukturaviy TITLE-ABS-KEY so'rovi orqali olindi. 2010-yildan 2025-yil mart oyigacha ingliz tilida nashr etilgan yakuniy bosqichdagi ilmiy ishlar tanlab olindi. Yakuniy ma'lumotlar to'plami 86 ta hujjatdan iborat bo'ldi. Yillik nashrlar soni, hissa qo'shgan mamlakatlar, fan sohalari, hujjat turlari va nashr manbalari bo'yicha tavsifiy bibliometrik tahlil amalga oshirildi. Nashr faolligi 2013-yildan keyin sezilarli darajada oshib, 2019 va 2020-yillarda eng yuqori ko'rsatkichga yetgan hamda har bir yilda 12 tadan hujjat chop etilgan. Italiya 31 ta hujjat bilan yetakchi o'rinni egallagan, undan keyingi o'rinlarni AQSh – 14 ta, Gretsiya – 8 ta va Buyuk Britaniya – 6 ta hujjat bilan egallagan. Muhandislik hamda Yer va sayyoralar haqidagi fanlar Scopus tasnifidagi yetakchi yo'nalishlar bo'lib, ularning har biri 55 tadan ortiq hujjat bilan bog'langan. Konferensiya materiallari umumiy ma'lumotlar to'plamining 43,0 foizini, ilmiy maqolalar 39,5 foizini, kitob boblari esa 14,0 foizini tashkil etgan. Natijalar mazkur ilmiy yo'nalishning yuqori darajada fanlararo xususiyatga ega ekanini hamda tadqiqotlar asosan seysmik faol va tarixiy-madaniy meros obyektlariga boy mamlakatlarda jamlanganini ko'rsatadi. Tahlil kelgusidagi tadqiqotlarda tarixiy g'isht-tosh konstruksiyalarni baholashni hududga xos geotexnik tavsiflash, grunt–inshoot o'zaro ta'sirining dinamik tahlili, raqamli monitoring va takror ishlab chiqish mumkin bo'lgan hisoblash jarayonlari bilan yanada uzviy integratsiyalash maqsadga muvofiqligini ko'rsatadi.

Kalit so'zlar: tarixiy g'isht-tosh konstruksiyalar; madaniy meros; seysmik baholash; grunt–inshoot o'zaro ta'siri; geotexnika muhandisligi; bibliometrik tahlil; Scopus.

Аннотация. Оценка исторических каменных и кирпичных памятников, расположенных в сейсмоактивных регионах, требует комплексного учета не только конструктивной уязвимости, но и влияния фундаментов и местных грунтовых условий. В исследовании проведен библиометрический анализ развития научных работ, индексируемых в базе Scopus, на пересечении направлений, связанных с историческими каменными и кирпичными конструкциями, сейсмической оценкой и взаимодействием грунта и сооружения (SSI). Библиометрические данные были получены из базы Scopus в марте 2025 года с использованием структурированного запроса TITLE-ABS-KEY, объединяющего термины, относящиеся к историческим и культурным объектам с каменными и кирпичными конструкциями, сейсмостойкому строительству, сейсмическому усилению, взаимодействию грунта, фундамента и сооружения, реакции площадки и геотехническим характеристикам. Были отобраны окончательно опубликованные англоязычные работы за период с 2010 года по март 2025 года. Итоговая выборка включала 86 документов. Проведен описательный библиометрический анализ годовой публикационной активности, вклада стран, предметных областей, типов документов и источников публикаций. Публикационная активность заметно возросла после 2013 года и достигла максимального уровня в 2019 и 2020 годах – по 12 документов в каждом году. Италия заняла лидирующую позицию с 31 документом, за ней следовали США – 14, Греция – 8 и Великобритания – 6 документов. Инженерные науки, а также науки о Земле и планетах являлись ведущими предметными областями Scopus, каждая из которых была представлена более чем 55 документами. Материалы конференций составили 43,0% выборки, научные статьи – 39,5%, главы книг – 14,0%. Полученные результаты свидетельствуют о выраженном междисциплинарном характере данного научного направления и концентрации исследований преимущественно в сейсмоактивных странах с богатым историко-культурным наследием. Проведенный анализ также указывает на целесообразность более тесной интеграции оценки исторических каменных и кирпичных конструкций с геотехнической характеристикой конкретных площадок, динамическим анализом взаимодействия грунта и сооружения, цифровым мониторингом и воспроизводимыми вычислительными процессами.

Ключевые слова: исторические каменные и кирпичные конструкции; культурное наследие; сейсмическая оценка; взаимодействие грунта и сооружения; геотехническая инженерия; библиометрический анализ; Scopus.

Abstract. Historic masonry monuments located in earthquake-prone regions require assessment strategies that integrate structural vulnerability with the effects of foundations and local ground conditions. This study examines the development of Scopus-indexed research at the intersection of historic masonry, seismic assessment, and soil–structure interaction (SSI) through bibliometric analysis. The bibliometric dataset was retrieved from Scopus in March 2025 using a structured TITLE-ABS-KEY query combining terms related to historic and heritage masonry, earthquake engineering, seismic strengthening, soil–foundation–structure interaction, site response, and geotechnical behavior. English-language final-stage publications from 2010 to March 2025 were retained, resulting in a final dataset of 86 documents. Descriptive bibliometric analysis was conducted to assess annual publication output, contributing countries, subject areas, document types, and publication sources. Publication activity increased markedly after 2013 and reached its highest level in 2019 and 2020, with 12 documents published in each year. Italy was the leading contributor with 31 documents, followed by the United States with 14, Greece with 8, and the United Kingdom with 6. Engineering and Earth and Planetary Sciences were the dominant Scopus subject areas, each associated with more than 55 documents. Conference papers accounted for 43.0% of the dataset, articles for 39.5%, and book chapters for 14.0%. The findings indicate that the research field is strongly interdisciplinary, while publications remain concentrated primarily in seismically active countries with rich cultural heritage. The analysis also identifies an opportunity for further methodological development: future research should more explicitly integrate structural assessment of historic masonry with site-specific geotechnical characterization, dynamic SSI analysis, digital monitoring, and reproducible computational workflows.

Keywords: historic masonry; cultural heritage; seismic assessment; soil–structure interaction; geotechnical engineering; bibliometric analysis; Scopus.

INTRODUCTION

Historic masonry buildings, monuments, mosques, madrasahs, churches, towers, and other heritage structures are physical records of architectural and engineering development across centuries. Their preservation is particularly challenging in seismically active regions, where brittle masonry, irregular geometry, material degradation, previous alterations, and uncertain construction details can combine to produce complex failure mechanisms. For many heritage structures, the foundation and supporting ground are also integral components of this vulnerability system rather than merely passive boundary conditions.

Seismic assessment of historic masonry has traditionally focused on the superstructure: wall stability, in-plane and out-of-plane mechanisms, diaphragm action, local collapse modes, and the effectiveness of strengthening interventions. Contemporary reviews confirm that the choice of assessment method depends strongly on scale, available knowledge, and the level of modeling detail [4]. However, earthquake response can also be influenced by local site effects, foundation flexibility, settlement, rocking, ground amplification, liquefaction susceptibility, and the transfer of dynamic energy across the soil–foundation–structure interface. Recent case studies show that SSI can materially affect the predicted seismic response of historic masonry structures, particularly on deformable soils [5, 6].

During the last decade, the development of nonlinear finite-element analysis, discrete and macro-element modeling, ambient-vibration testing, terrestrial laser scanning, remote sensing, digital twins, and structural health monitoring has broadened the methodological basis for heritage assessment. Reviews of heritage masonry monitoring demonstrate the expanding role of non-destructive testing and structural health monitoring technologies in diagnosis and conservation [7]. In parallel, geotechnical earthquake engineering has provided increasingly refined approaches to site response and dynamic SSI. These two research traditions are closely related, although their integration within individual studies remains an area for further methodological development. Mapping how the literature has developed is therefore useful for identifying dominant research communities, publication channels, and opportunities for further interdisciplinary integration.

Bibliometric analysis provides a reproducible approach to evaluating the structure and development of a scientific field using publication metadata. It is particularly appropriate when the goal is to examine research output, disciplinary distribution, geographical contributions, and publication outlets rather than to estimate a pooled engineering effect size. Methodological guidance emphasizes the importance of transparent database selection, search strategies, inclusion criteria, and interpretation of bibliometric indicators [1].

The original dataset examined in this study was assembled from Scopus and contains 86 records jointly addressing historic or heritage masonry, seismic assessment or strengthening, and geotechnical or SSI-related concepts. The present paper reformulates that material as a complete IMRAD article, ensures consistency in the observation period by treating 2025 as a partial year through March, and reports the descriptive results without inferring causal explanations that cannot be established from bibliometric metadata alone.

Accordingly, this study addresses five research questions: (RQ1) How did annual publication output change from 2010 to March 2025? (RQ2) Which countries contributed the largest number of documents? (RQ3) Which subject areas dominate the literature? (RQ4) Which document types are most common? and

(RQ5) Which publication sources most frequently disseminate research in this interdisciplinary domain?

LITERATURE REVIEW

Puncello and Caprili systematically reviewed approaches to the seismic assessment of historical masonry buildings at different scale levels and emphasized that geometric characteristics, mechanical properties of materials, structural connections, and the selection of analytical models can significantly influence seismic assessment results [4]. Lourenço et al. examined simplified indexes for the seismic assessment of masonry buildings using an international database and demonstrated their applicability for the preliminary seismic evaluation of large building stocks [8].

Wang et al. investigated the performance-based seismic assessment of a historic high-rise masonry building by explicitly considering soil–structure interaction (SSI), demonstrating the relevance of SSI to the dynamic and seismic response of masonry structures [5]. Genç et al. evaluated the effects of soil–structure interaction on the structural performance of historical masonry buildings under different earthquake input models [6]. Similarly, Shabani and Kioumarsi investigated the seismic assessment and strengthening of a historical masonry bridge while considering SSI, highlighting the importance of incorporating soil conditions into structural models when evaluating the seismic behavior of heritage structures [9].

Soleymani, Jahangir, and Nehdi systematically reviewed damage detection and monitoring techniques for heritage masonry structures and highlighted the potential of modern monitoring and diagnostic methods for structural condition assessment [7]. For the quantitative synthesis of research in this field, the bibliometric principles proposed by Donthu et al. provide a methodological basis for examining publication trends, sources, countries, and major research directions [1]. VOSviewer, developed by van Eck and Waltman, provides tools for bibliometric mapping and visualization [2], while the PRISMA 2020 guidelines presented by Page et al. support transparent and systematic reporting of literature identification and screening procedures [3].

RESEARCH METHODOLOGY

Study Design. This study employed a descriptive bibliometric design based on publication metadata indexed in Scopus. Bibliometric methods are suitable for identifying the development, intellectual structure, and performance patterns of a research domain when the analytical unit is the scientific publication rather than the individual engineering structure [1]. The analysis presented in this paper is intentionally limited to performance indicators that can be supported by the available source dataset.

The search was conducted in March 2025. Because the dataset contains records assigned to 2025, that year is treated as a partial publication year rather than a complete annual observation. The analytical interval is therefore reported as **2010–March 2025**. The dataset contains no publications for 2011; however, the zero value is retained in the annual series to preserve the continuity of the observation period.

Database and Search Strategy. Scopus was selected as the sole bibliographic database in the source study. The search was performed in the title, abstract, and keyword fields using the following expression:

TITLE-ABS-KEY ((“historic masonry” OR “heritage masonry” OR “cultural heritage structure” OR “historic building*” OR monument* OR madrasah* OR mosque*) AND (“seismic retrofit*” OR “seismic strengthening” OR “seismic assessment” OR “seismic vulnerabilit*” OR “earthquake engineering”) AND (“soil-structure interaction” OR “soil-foundation-structure interaction” OR “site response” OR “local site effect*” OR “dynamic soil characteristic*” OR “foundation behavior” OR “ground response analysis” OR “shear wave velocity” OR settlement OR liquefaction OR geotechnical*))

The source material states that only English-language publications at the final publication stage were retained. The dataset was restricted to research relevant to the combined themes of cultural heritage masonry, seismic behavior, and soil/foundation effects. No additional records were added from Web of Science, Dimensions, OpenAlex, or Google Scholar.

Bibliometric Indicators and Data Treatment. The final dataset contained 86 documents. Five groups of indicators were analyzed: (1) annual publication output, (2) country contributions, (3) Scopus subject-area classifications, (4) document types, and (5) publication sources. The figures were reconstructed in English from the numerical information contained in the source document.

Annual output was calculated as the number of indexed documents assigned to each publication year. Country contributions were reported as document counts associated with the leading countries in the source dataset. Because Scopus records may include international co-authorship, country totals should not be interpreted as mutually exclusive shares of the 86 documents. The same consideration applies to subject-area classifications because one publication can be assigned to more than one Scopus subject area.

Document-type percentages were calculated using the 86-document dataset as the denominator. The source distribution corresponds to 37 conference papers, 34 journal articles, 12 book chapters, and one record each classified as a review, conference review, and book. Publication-source counts were reported for the eight outlets with the highest frequencies shown in the source analysis.

Network-based science-mapping indicators, such as author co-citation, bibliographic coupling, and keyword co-occurrence, were not reconstructed because the underlying record-level export was not supplied. Although software such as VOSviewer can be used for these analyses [2], including such networks without the original export would result in findings that are not directly supported by the available dataset.

Reporting Quality and Limitations of the Method. The search string and selection rules are reported explicitly to improve reproducibility. General principles of transparent review reporting, including complete search descriptions and clear study-selection methods, are consistent with the rationale of PRISMA 2020 [3], although the present work is a bibliometric performance analysis rather than a clinical systematic review. The principal methodological considerations include the use of a single database, restriction to English-language records, the relatively small dataset, possible indexing changes over time, and the partial coverage of 2025.

ANALYSIS AND RESULTS

Annual Publication Output. The 86 publications show a non-linear but generally increasing research trajectory. Only one document was recorded in 2010, and none were recorded in 2011. Publication activity increased sharply in 2013, when nine documents were indexed, and fluctuated thereafter. The highest annual output was recorded in 2019 and 2020, with 12 documents in each year. Output remained substantial in 2021 and 2022, with eight and seven documents, respectively, decreased in 2023, and increased again to nine documents in 2024. The three documents assigned to 2025 represent only a partial year because the Scopus search was conducted in March 2025.

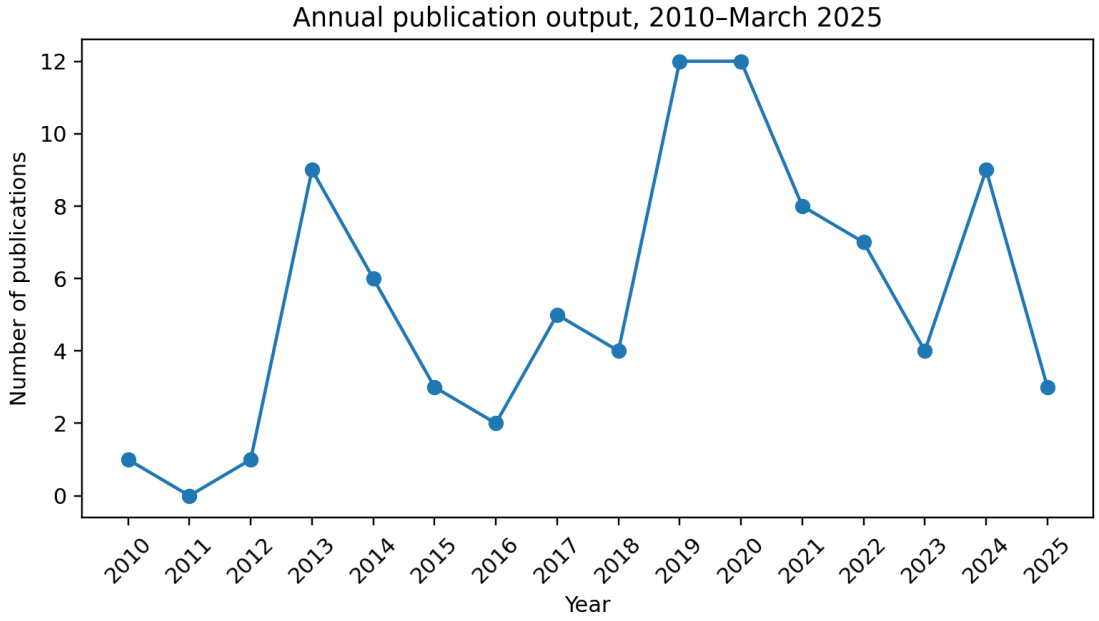


Figure 1. Annual publication output in the Scopus dataset, 2010–March 2025 (n = 86)[1]

Geographical Contribution. Italy was the most frequently represented country in the dataset, with 31 documents, more than twice the number associated with the United States (14). Greece contributed eight documents, while the United Kingdom contributed six. Turkey recorded five documents, while Egypt, Peru, and Spain each had four; China and Germany each had three among the leading countries shown in the source analysis. These counts indicate that the research field is strongly represented in countries combining substantial masonry heritage with active earthquake-engineering and conservation research communities.

1 Source: Author's elaboration.

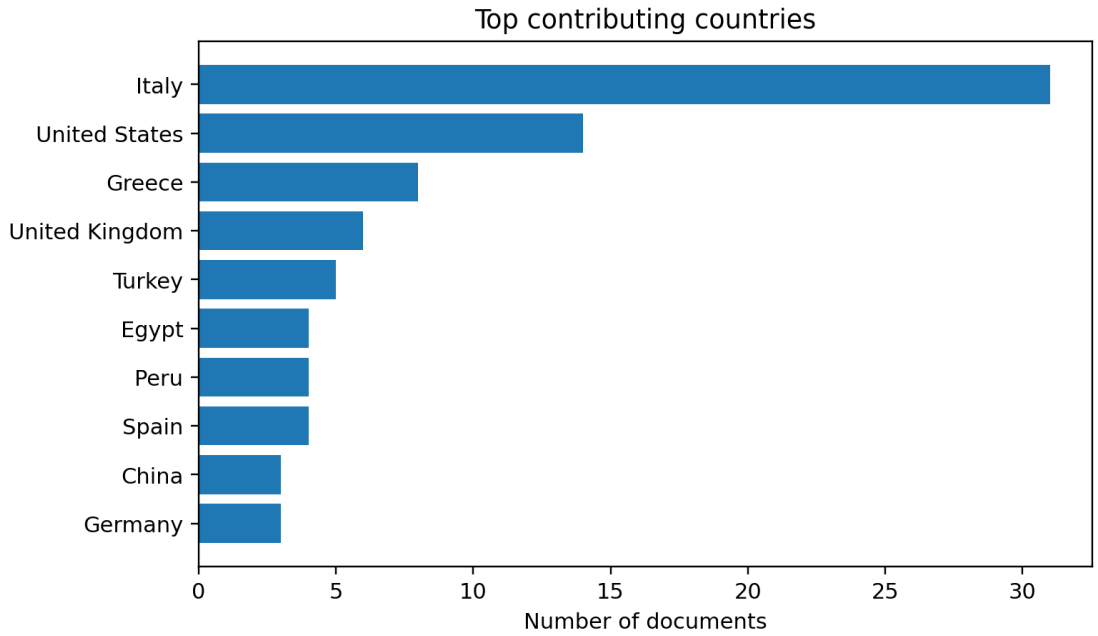


Figure 2. Leading contributing countries in the source dataset. Country counts may overlap because of international co-authorship[2]

Subject-Area Distribution. The disciplinary profile is dominated by Earth and Planetary Sciences and Engineering, each linked to approximately 56 records in the source analysis. Environmental Science is the next largest category, with 14 records, followed by Mathematics, with nine. Smaller contributions were recorded in Social Sciences, Agricultural and Biological Sciences, Arts and Humanities, and Energy. Because Scopus allows multiple subject-area assignments, these values are not additive to the total number of documents.

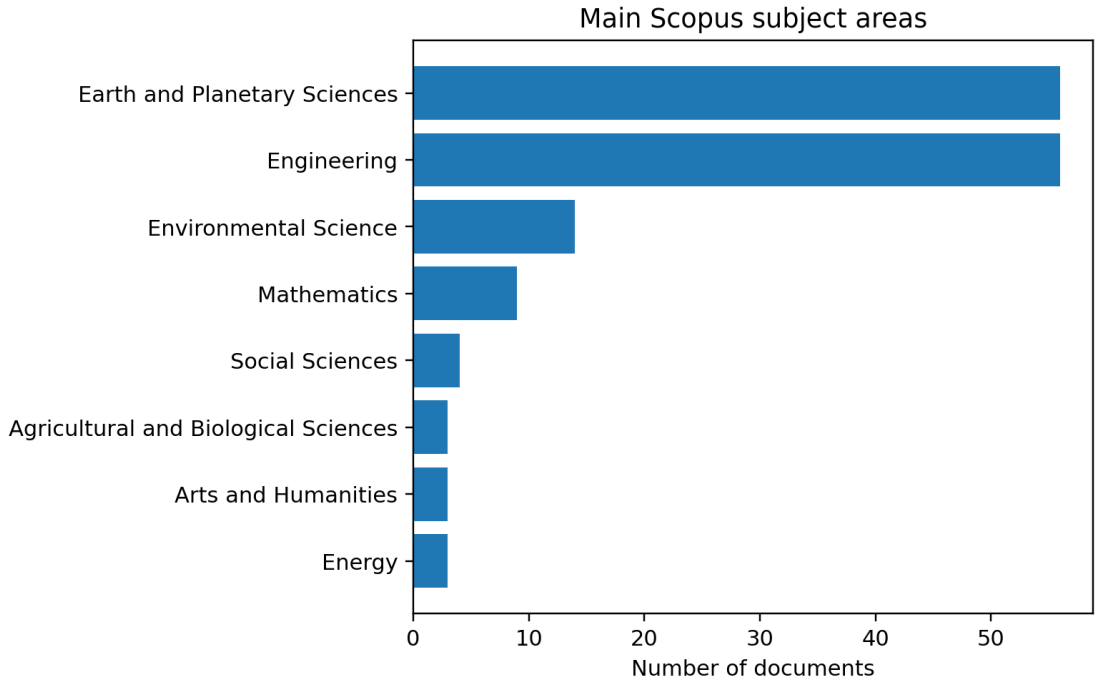


Figure 3. Main Scopus subject areas represented in the bibliometric dataset[3]

Document Types. Conference papers form the largest document category, accounting for 37 of the 86 records (43.0%). Journal articles represent 34 records (39.5%), while book chapters account for 12 records

2 Source: Author's elaboration.
3 Source: Author's elaboration.

(14.0%). Reviews, conference reviews, and books each contribute one document (1.2%). Thus, peer-reviewed journal articles and conference papers together account for more than four-fifths of the dataset.

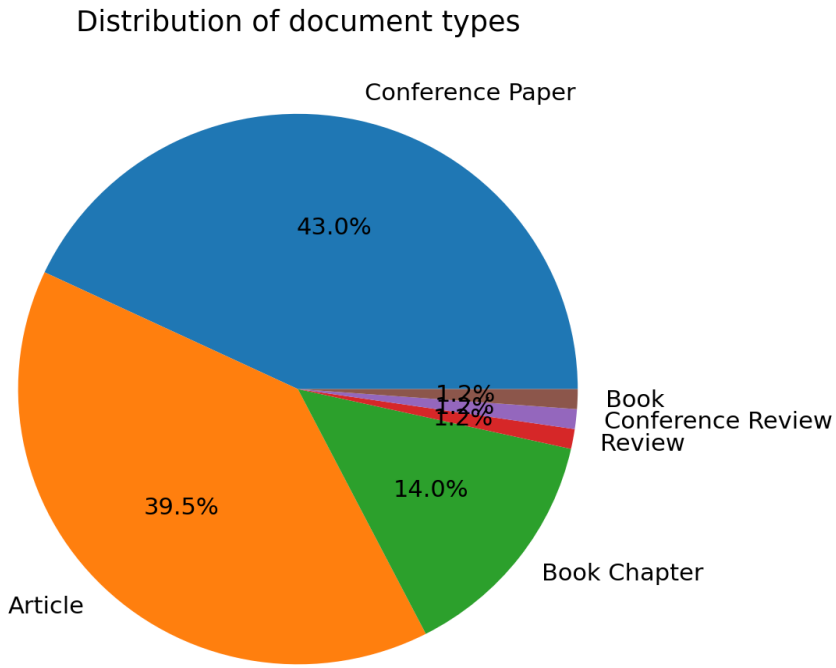


Figure 4. Distribution of document types in the Scopus dataset (n = 86).

Leading Publication Sources. The most frequent publication venues shown in the source material are COMPDYN Proceedings and the World Conference on Earthquake Engineering Proceedings, with six documents each. *Bulletin of Earthquake Engineering*, *Engineering Structures*, *Lecture Notes in Civil Engineering*, and *Natural Hazards* each account for four documents, while *RILEM Bookseries* and *Sustainable Civil Infrastructures* each account for three. The distribution indicates that research on this topic is disseminated through both archival journals and specialist earthquake-engineering conference channels.

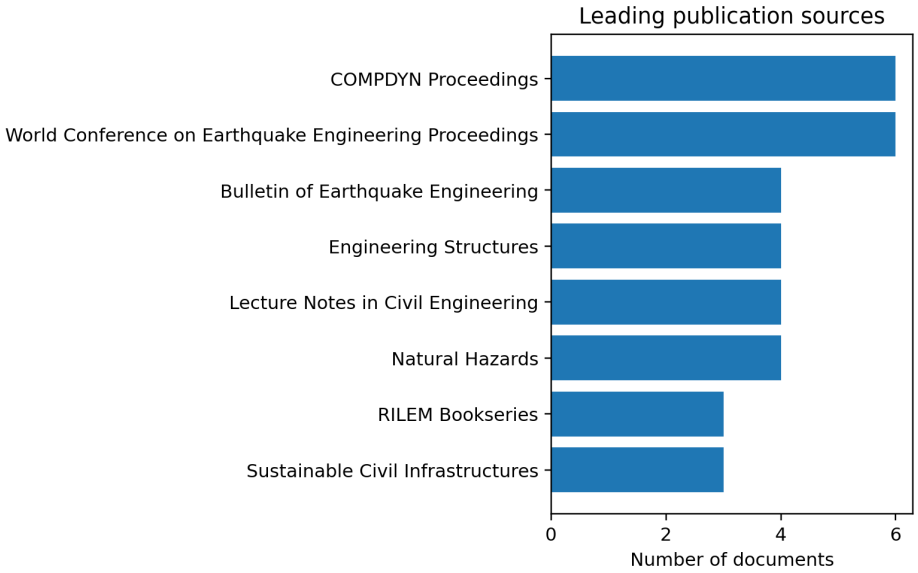


Figure 5. Leading publication sources represented in the dataset[4]

Summary of Principal Bibliometric Characteristics

4 Source: Author's elaboration.

Table 1
Main characteristics of the analyzed publication set[5]

Indicator	Result
Database	Scopus
Search date	March 2025
Coverage	2010–March 2025
Documents	86
Language filter	English only
Peak publication years	2019 and 2020 (12 documents each)
Leading country	Italy (31 documents)
Dominant subject areas	Earth and Planetary Sciences; Engineering
Largest document type	Conference paper (43.0%)
Main thematic intersection	Historic/heritage masonry + seismic assessment/strengthening + soil/foundation/SSI

The bibliometric pattern indicates that research integrating historic masonry, earthquake engineering, and ground–foundation effects has developed into a recognizable interdisciplinary research area. The increase after 2013 and the peak in 2019–2020 are consistent with a broader shift toward performance-based assessment, numerical modeling, and risk-informed conservation. At the same time, bibliometric growth should be interpreted primarily as evidence of increasing research activity in this area; the search strategy identifies publications in which both structural and geotechnical concepts are present, while the extent of their methodological integration may vary among individual studies.

The strong representation of Italy is consistent with its substantial stock of historic masonry and its long-standing earthquake-engineering and conservation research traditions. This context is also reflected in international work on simplified and performance-based assessment of masonry monuments and heritage buildings [8]. The substantial contributions from the United States, Greece, the United Kingdom, Turkey, Egypt, Peru, and Spain demonstrate that the topic extends across diverse seismic and heritage contexts. The observed geographical concentration also provides an opportunity to expand the representation of other heritage regions through broader language coverage, database inclusion, Scopus visibility, and the use of diverse search terminology.

The dominance of Engineering and Earth and Planetary Sciences is a key finding. Historic masonry conservation is often approached as an architectural or cultural-heritage issue, while the analyzed publication set is predominantly rooted in structural mechanics, earthquake engineering, geotechnics, and site-response analysis. This disciplinary structure provides a strong technical basis for seismic safety and creates opportunities for closer integration with conservation science, architectural history, materials characterization, and heritage management when intervention decisions are made.

The high proportion of conference papers warrants careful interpretation. Earthquake engineering relies extensively on major international conferences for the rapid dissemination of analytical methods, case studies, and post-earthquake observations. Conference output can therefore indicate an active research community. In parallel, the continued development of the field can be supported by detailed archival journal publications that provide comprehensive model descriptions, validation data, and reproducible assumptions. The nearly equal share of journal articles indicates that the transition from exploratory work toward more consolidated research is already underway.

The publication-source profile reinforces this interpretation. Specialized proceedings such as COMPDYN and the World Conference on Earthquake Engineering coexist with journals including *Bulletin of Earthquake Engineering*, *Engineering Structures*, and *Natural Hazards*. This combination reflects the multi-scale nature of the problem: structural response, seismic hazard, site effects, foundation behavior, and conservation decisions are addressed across partially overlapping research communities.

From an engineering perspective, an important direction for further research is the development of integrated workflows in which the superstructure, foundation, and ground are represented consistently. A heritage masonry model may incorporate a high level of structural detail while using a simplified representation of base conditions; similarly, a sophisticated site-response model may benefit from more detailed representation of the nonlinear and discontinuous behavior of historic masonry. Published studies of historic masonry buildings and bridges demonstrate the value of explicitly considering SSI in seismic assessment and model updating [5,

5 Source: Author's elaboration.

6, 9]. Future studies can further connect these levels by using calibrated soil properties, foundation geometry, realistic masonry constitutive models, and measured dynamic characteristics.

Monitoring and digital technologies can support this integration. Ambient-vibration measurements, accelerometer arrays, satellite or terrestrial deformation monitoring, photogrammetry, and laser scanning can provide evidence for model updating. Machine-learning techniques may assist with pattern recognition, damage classification, or surrogate modeling and can effectively complement mechanics-based interpretation, particularly when training datasets are appropriately developed and heritage interventions require transparent and explainable decision-making.

The dataset also has implications for Central Asian heritage research. The search expression explicitly includes madrasahs and mosques, while the leading-country distribution is predominantly represented by Europe and North America. This pattern highlights opportunities for expanding Scopus-indexed research on the seismic vulnerability of historic masonry in Central Asia, including monuments founded on loess, alluvial, or other settlement-sensitive soils. Such studies would be particularly valuable when geotechnical investigations, material testing, structural identification, and intervention criteria are reported in a reproducible manner.

Methodological Limitations. First, Scopus was the sole database used in the analysis. Accordingly, the results specifically represent the literature indexed in Scopus. Expanding future analyses to records indexed in Web of Science, regional databases, institutional repositories, and local-language journals could provide broader bibliographic coverage.

Second, the analysis was restricted to English-language documents. Future multilingual searches could further increase the representation of research from countries with substantial historic masonry heritage where technical literature is frequently published in Italian, Spanish, Turkish, Persian, Arabic, Russian, Chinese, and other languages.

Third, 2025 represents a partial observation year because the search was performed in March. Accordingly, the 2025 publication count should be interpreted in the context of partial-year coverage rather than as a complete annual trend.

Fourth, the available source file contains aggregated outputs rather than complete exported metadata. Consequently, citation-normalized impact, author collaboration networks, keyword co-occurrence, bibliographic coupling, and co-citation structures were retained outside the scope of the present analysis and may be examined in future research when complete record-level metadata are available.

Finally, country and subject-area counts may overlap because of multi-country authorship and multiple Scopus classifications. These indicators therefore describe participation and disciplinary representation rather than mutually exclusive partitions of the dataset.

CONCLUSION AND RECOMMENDATIONS

This study provides a structured bibliometric overview of Scopus-indexed research connecting historic masonry, seismic assessment, and soil–structure interaction from **2010–March 2025**. The analyzed dataset contains 86 English-language documents. Research activity expanded substantially after 2013 and reached its highest annual output in 2019 and 2020. Italy was the most frequent national contributor, followed by the United States, Greece, and the United Kingdom. Engineering and Earth and Planetary Sciences dominate the disciplinary profile, while conference papers and journal articles account for the great majority of publications.

The findings demonstrate the interdisciplinary nature of the field and indicate opportunities for broader geographical representation and further methodological integration. An important direction for future work is the development of integrated, validated assessment frameworks that combine masonry mechanics, foundation behavior, site response, and geotechnical uncertainty. Broader database coverage, multilingual searches, and record-level science mapping could also enhance future bibliometric studies.

For engineering practice, the central implication is that the seismic safety of historic masonry can be evaluated through an integrated approach that considers both the walls and superstructure and, where relevant, the supporting ground and foundations. Where ground conditions, foundation flexibility, or local amplification are significant, soil–foundation–structure interaction can be incorporated as part of the heritage system. Future research combining structural modeling with geotechnical investigation, monitoring, and transparent data reporting can contribute to both scientific understanding and the reliability of conservation decisions.

Future bibliometric studies can update the dataset using multiple databases and provide the raw export as supplementary material. A reproducible workflow could combine Scopus and Web of Science records, deduplicate them, harmonize author and affiliation names, and subsequently apply keyword co-occurrence, co-authorship, bibliographic coupling, and co-citation analyses. VOSviewer or equivalent software can support such mapping when record-level data are available [2].

Future engineering studies can prioritize case studies in which geotechnical and structural data are collected together. Recommended variables include shear-wave velocity, stratigraphy, groundwater conditions, foundation geometry, masonry mechanical properties, crack patterns, modal frequencies, damping, and recorded or scenario earthquake inputs. Such datasets would enable researchers to quantify the conditions under which SSI materially changes predicted demands and those under which a fixed-base approximation remains adequate.

A further research priority is the development of regional evidence from heritage zones that can benefit from broader representation in the international literature. Central Asia, the Middle East, and parts of South Asia contain extensive earthen and fired-brick monumental heritage in seismically active areas. Publishing well-documented case studies from these regions would broaden the empirical basis of the field and contribute to greater geographical diversity in future analyses.

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