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Ingénieries innovantes ?

Vilma Fasoli et Francesca B. Filippi

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Vilma Fasoli et Francesca B. Filippi

The penetration of Italian professionals in the context of the Siamese modernization

Introduction: topics and sources

1 Starting in the mid-19th century, Siam opened up to penetration by Western construction-industry professionals and companies. The Italian presence endured, as a long-lasting phenomenon. Initially linked to projects by individual contractors, it gradually intensified, thanks to the signing of commercial agreements with Italy, and was strengthened through personal relationships that developed between the members of the royal families ruling the two countries (the Chakri and Savoia families). This paper expands on prior research[1] that has investigated the role played by Italian professionals, technicians, and entrepreneurs in the modernization process in foreign countries. Our goal in this article is to deepen our analysis[2] of certain aspects of this process, drawing particular attention to the sites for the construction of some reinforced concrete and iron bridges built in Siam over a period of almost 40 years (1894-1932). As it was recently observed,[3] the considerable technological expertise required for these structures helped assert the authority of Western enterprises and construction systems (Hennebique and Eiffel, in this case) outside Europe In any case, for the sovereigns of Siam, bridges mainly took on great symbolic value as the settings for dynastic celebrations, being capable of lending shape to the international and modern image the Siamese royal family wanted to convey. On the sites we examined, Italian and French professionals and businesses were constantly engaged in fierce competition with one another. Relations were ambiguous, vacillating between Siam's need to recruit European technicians, and its equally important need to resist the political and economic pressure exerted by European firms.

2 On the one hand, it is true that attention to bridge construction involves tracing the various stages of the transition from traditional wooden constructions to those in reinforced concrete with metal structures. However, the aim of this study is to study this transition for what it reveals of the problems connected with the processes of adaptation to the colonial context, the relationships between the proponents of change, and the various forms of competition between companies. As a result, the researchers were confronted by the problem of the dispersion of both public archives (in Italy, France, and Thailand) and private archives (those of businesses and professionals). The sources investigated demanded constant analysis and cross interpretation between different forms of "writing": technical reports drafted by contractors, correspondence with engineers, articles in journals, technical reports and celebratory texts presented during exhibitions, dispatches from diplomats, and mechanisms for recruiting skilled technicians and professionals.

3 We are aware that the scholar attempting to reconstruct the history of a construction site inevitably faces the fragmentation of the sources (including some gaps that can never be filled). Interpretation leads to conjecture that may never be fully resolved. However, this study observes the construction site as the nexus of a close-knit and complex network of relationships, skills, and cultures, intervening to design its specificity.

Western technique in the face of the uncertain balance between Siam and foreign powers

4 Beginning in the 1850s, the policies of the kings of Siam focused on giving the kingdom a high level of *siwilai* (civilisation) by promoting a modernization plan which was implemented over almost 80 years (1855-1932).[4] King Rama V (1853-1910) collected the Western cultural references and models that underpinned this plan in the course of several journeys to various Asian colonies (Java, India, Singapore) and to European capital cities (in 1897 and then in 1907).[5] Another source was Siam's participation in international exhibitions.[6] However, above all, ministers, officials, and other prominent Siamese civil servants were groomed

for leadership by training in European schools. Historians agree that Siam's kings were quite successful in preventing the country from being conquered by a foreign power, while maintaining central role for it in the Southeast Asian colonial economy, run by Britain and France in India and Indochina respectively. Recognized as an independent kingdom by the French-British agreement of 1896, Siam experienced a strong renewal, under the reign of King Rama V.[7] This boost was driven by a push for administrative rationalization which reached every sector of the government, and upgraded systems for legislation, education, defense, international policy, economy, and public works. The rhetoric of symbols and languages often used to celebrate the image of the king and the Chakri dynasty was flanked by interventions aimed at giving shape to Siam's international image, where the staging of progress was achieved through high-tech, modern constructions. In this process, the coexistence of projects emphasized the break with the past, on the one hand, while, on the other hand, refocusing attention on the centrality of the relationship between the king as an authority figure and Bangkok, the capital city. The transformation of the Siamese territory was preceded and accompanied by the renewal of Bangkok. For example, in 1863, an extensive road network was built as a partial substitution for the traditional system of river transport. It succeeded in changing the face of the capital from "water city" to "land city". Also decisive for Bangkok was Rama's decision to move the ancient royal palace from the citadel, in the heart of the capital, to the new Throne Hall, built on the area of the Dusit Suan (celestial garden).[8] The monarch also planned to redesign the structure of entire districts of the city and develop its infrastructural links with the rest of the country. From 1896, work on organizing the transport network accelerated, guaranteed by a consistent policy of investment in the railway construction. Thanks to these new lines, Siam gradually moved into a key role in the trade links between British markets in Malaysia and French markets in Indochina. Between 1874 and 1907, the flow of income into the king's treasury rose from 1.6 million *baht* to no less than 57 million. This figure is the most striking evidence of the success of Rama's policies of centralizing administration and taxation. These revenues funded the building frenzy characterizing Siam at the end of the 19th-century. Regulating the construction and public works markets and appointing Siamese officials to head ministries, Rama instituted order in the confusion of private licenses and contracts, often funded with foreign capital. He rapidly did away with the standard practice of granting construction and management rights to Western companies. These choices, however, slowed the implementation of the public works plan, due to the absence of engineering and other technical schools and institutes for builders and planners.[9] Similarly, the kingdom lacked local companies for the production of non-traditional building materials like concrete, as well as companies equipped with heavy machinery suited to the construction of large works using innovative techniques. This said, these policies created an abundance of work opportunities for Europeans and Americans, along with the possibility of employment in the kingdom's civil service. The fact that foreign professionals were hired by the government contributed to the even deeper absorption of Western influences by the Siamese state. It also highlighted how heavily the assignments were influenced by the balances between the colonial powers and Siam. Professionals who were able to rely on the neutrality of the mother country in the international race towards colonial expansion were the candidates most likely to succeed in Siam. In 1902, of 190 foreign nationals employed by the government, there were only 7 Italians, compared to 90 British, 41 Germans, 35 Danes, 8 Belgians and 2 French.[10] In 1905, there were 30 Italians, 11 of whom were employed by the Department of Public Works. However, the highest concentration was reached during the construction of the Throne Hall (1907-16).[11] This site is recognized as having been particularly important, due to the role played by Italian professionals as mediators, introducing Western architectural culture and experiment with its technique in Siam. On the one hand, the site proved the positive outcome of the close collaboration between academically trained architects and engineers from polytechnic institutes. On the other hand, the Throne Hall marked an important turning point in the country's modernization, being the first use of Hennebique-system reinforced concrete structures. The fact that the French company Hennebique was engaged for this project

was mainly due to the endorsement of expatriates from Turin (the home city of the Italian Hennebique associate Giovanni Antonio Porcheddu) in the Siamese Department of Public Works. Mario Tamagno and Annibale Rigotti, who drew up the project for the Throne Hall, were both graduates of Turin's Accademia Albertina. Emilio Giovanni Gollo, in particular, a graduate in industrial engineering from the School of Application for Engineers in Turin (which later became the Polytechnic), was responsible for the structural design of the Palace and many other reinforced concrete works commissioned by the Royal Household to the Department of Public Works. Before beginning his career in Siam, Emilio Giovanni Gollo had already had opportunities to approach the use of reinforced concrete, thanks to Italian education programmers aimed at cultivating the link between theory and practice, and training and business. In Turin, this link had been consolidated via the introduction of the study of reinforced-concrete technique in courses and construction workshops, even before a theory for the calculation of loads in reinforced concrete structures was formulated and taught at the School of Applications.[12] This was the result of the school's close ties with the Turin offices of the Porcheddu company, which was licensed by Maison Hennebique in 1894 for Northern Italy (and also later by the Societé par Compression Mécanique du Sol). By 1907, Porcheddu had already built more than 1000 structures using this system.[13]

5 In addition to its uniqueness as a monument, from a technical point of view, due to the complexity of the problems tackled during its construction, the Throne Hall project was valuable as an essential experience. It may have influenced decisions made by Maison Hennebique in the construction of reinforced-concrete works in the years immediately after the Throne Hall was edified. More generally, Bangkok, built on unstable, marshy land at 1.50 meters below sea level, is repeatedly subject to the risk of flooding. Such difficulties offered Western contractors and engineers a broad spectrum of opportunities for experimentation. Likewise, the capital and provinces were characterized by a network of canals, so many bridges were necessary. These works became one of the architectural subjects most commonly used to showcase technical and technological virtuosity, made even more impressive by the difficult soil conditions. From 1894, to strengthen the centrality of this design theme, Rama V introduced the construction of the capital's bridges into the plans for the celebration of the King's birthday and the kingdom's anniversaries. The last great span, the Memorial Bridge, was opened in 1932, just before the revolution and the exile of the king.

The introduction of reinforced concrete in Bangkok: an Italian-French connection by Francesca B. Filippi

6 The decision by the Kingdom of Siam to employ expatriate European consultants, engineers, and architects gave them a key role in the Siamese civil service. In particular, it increased the technical skills and know-how the country had at its disposal to achieve its construction aims. The government planned to endow Siam with important infrastructures that were feats of modern engineering. The consultants, whose story is still largely to be written, were required to provide expert opinion on the works to be carried out. They were allowed so much autonomy in choosing the people and businesses to whom they contracted the works that they became pivotal figures in the recruitment of more foreign professionals. In 1892, Belgian engineer Rolin-Jaequemyns was hired as general adviser to the Kingdom.[14] He undertook the recruitment of a new railway systems engineer. The letter he wrote as part of his search in Europe for "a first-rate engineer, belonging to a neutral state, capable of being a good consultant to the Minister of Public Works"[15] highlights the ambiguous relationship between the Siamese government's recruitment needs and the political pressure imposed by foreigners in Siam. The fact that European nations were implicitly competing for the assignments is attested by clear divisions of the assignments by nationality. The British, in particular, prevailed for a long time in the fields of finance, education, police, and railways. Danes dominated the navy; Germans, the postal services and railways; and Italians gained a strong and widely recognized role in architecture, along with German and French building professionals, prominent in public works and infrastructure.[16] The presence of all of these expats was contingent to a great degree on the teetering balance of power between Siam

and the European colonial countries operating in South East Asia. For example, after the "Paknam incident" (1893), when three French ships were fired on by a Siamese fort and force of gunboats, the number of French professionals decreased considerably.[17] Despite the internationally renowned skills, particularly in the Public Works sector, of the French builders, this incident placed them at a serious disadvantage, along with contractors from other European nations who had become *protégés* of France. On this matter, it is interesting to note the 1903 letter from the Italian consul Riccardo Motta to his home ministry in Rome: "The French […] want the best places [….]. I shall not allow them to interfere with the progress already made by our people at the engineering department of the Ministry of Public Works."[18] Italy's marginal role in colonial politics, along with close relations between the Chakri dynasty and certain members of the Royal House of Savoy, greatly benefited Italian interests in this case. These relations, officially launched by the friendship and trade treaty signed between Italy and Siam in 1868, were consolidated over the years thanks to repeated exchange visits between the monarchs and diplomatic representatives of the two countries.[19] In 1911, on the occasion of the Siamese participation in the International Exhibition in Turin, Carlo Allegri, general manager of the Department of Public Works of the Kingdom of Siam, presented a report to Rama VI describing the department's staff in detail. The Engineering section included Emilio Giovanni Gollo (chief engineer); Giuseppe Canova, seconded to the State Railways; the provincial engineers, Edmondo Roberti, A. Spigno and M. Sala, and the assistants G. Levi, A. Facchinetti, L. Giacone, P. Coletti, G. Guasco and L. Baghini. The Architecture section comprised Mario Tamagno (chief architect) and Annibale Rigotti (present in Bangkok in 1907-09, and then active from Italy as consultant architect), G. Salvatore, Alfredo Rigazzi, Oreste Tavella, Ercole Manfredi, Bernardo Moreschi and Paolo Remedi. Other Italian staff members belonged to the painting, sculpting, plaster decorating, and marble crafting departments. These people were incorporated into the large number of Italian companies operating in the construction sector in Bangkok. The first traces of this international cooperation were documented in the mid-19th century, when work was carried out by the Grassi brothers'[20] company, where both Carlo Allegri and Paolo Remedi began their careers. Italian commercial penetration was quite limited but, from the end of the 1890s, Siam was reached by some member companies of the Consorzio Industriale Italiano per il Commercio con l'Estremo Oriente, based in Milan and founded in 1897 at the initiative of Manfredo Camperio.[21] Among them were the Società Italiana dei Cementi e delle Calci Idrauliche from Vittorio Veneto; the Novi marble studios from Genoa; S. Ghilardi and Co., a Milan engineering firm which manufactured cement and tiles, and Larini Nathan & Co., also based in Milan, whose activity covered roofs and beams, bridge construction, mechanical engineering, the design of power plants for drinking water supplies and hydraulic power transmission, and trade in steel components for railways and tramways.

7 Employment of Italian professionals in Siamese government offices reached a peak during the construction of the Royal Palace in Dusit Park. Positioned centrally in relation to the urban transformation projects underway in Bangkok and surrounded with a quadrangular fence, the park was a monumental complex. It consisted of a pavilion amid lawns and landscaping, crossed by canals and bridges connecting the Throne Hall to the other buildings. The languages of Western architecture dominated inside the Dusit, while outside the monumental Phra Lan (or Royal Plaza) was exalted by the Beaux-Arts-inspired layout of the streets, connecting to majestic Ratchadamnoen Avenue. The latter was dominated by the equestrian statue of Rama V and by the impressive Carrara marble mass of the southern facade of the Throne Hall.

8 Starting in 1907, architect Mario Tamagno studied designs for the Throne Hall several times before defining the classical version inspired by Italian renaissance and baroque architecture in cooperation with architect Annibale Rigotti, summoned from Italy specifically to work on the project. The building, developed according to a rectangular plan measuring 100x46 meters, was clad and decorated entirely with Carrara marble, surmounted by seven domes and semi-domes covered with gilded copper and bronze. The dome above the throne room reaches a height of over 40 meters and weighs an approximate total of 1500 tons. The main structure, designed by the Department's engineers, is mixed, with reinforced concrete

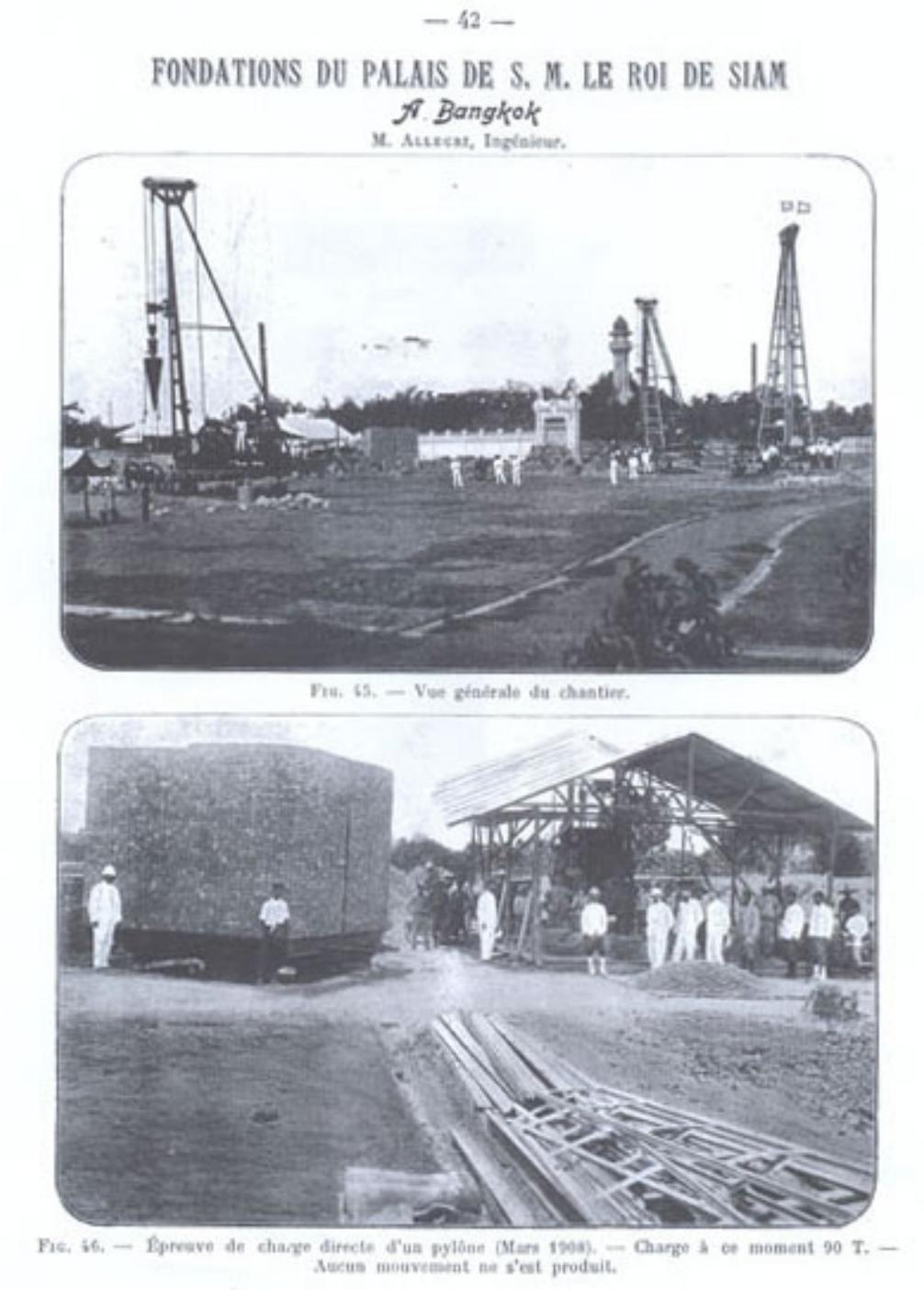
foundations and domes and brick walls. Due to the site chosen for Dusit Park (on particularly fragile soils once occupied by a paddy field) and the excessive weight of the Hall and its marble cladding, the construction of the foundations immediately proved to be an extremely complex and challenging operation. When the attempt at building brick foundations failed, engineers Carlo Allegri and Emilio Giovanni Gollo decided to contact the *bureau central* of the French company, Hennebique, for the project.

9 To understand the reasons for this choice, it is essential to reconstruct the complexity of the networks and relations that connected Bangkok to Turin and Paris. The interpretation proposed here is that, as a result of this choice, Italian engineers played a decisive role in the penetration of Siam by French construction companies. For different reasons, both Carlo Allegri and Emilio Giovanni Gollo were fully aware of the problems connected to the construction of foundations on unstable land, and of the reinforced concrete construction solutions the Hennebique system could offer. Having graduated in industrial engineering from Turin's School of Application for Engineers, Emilio Giovanni Gollo was equipped with an education that had combined courses in theory and workshops. The Museum of Industry on campus had given him an opportunity to further his knowledge of the Hennebique technique. Carlo Allegri, on the other hand, had never completed his degree. However, he came from an important family of construction contractors with extensive experience in bridge construction. Among the famous spans built by the Allegri family were the Regina Margherita and Umberto I Bridges in Rome, in 1891 and 1895, respectively.[22] In Turin, Eusebio Allegri's business had carried out prominent works in partnership with the Domenico Borini construction firm. Borini, who had learned the Dulac system for building foundations using pressurized caissons, later to be known as the Compressol system, when he was working in France with the Montagnier company,[23] became a specialist in foundation construction[24]. The Allegri-Borini partnership produced the Umberto I Bridge in Turin, completed in 1903. Located on the outskirts of Turin, in San Mauro Torinese, it was a challenging structure to build: its nine arches (each spanning 23 meters) stand on compressed-air foundations going 6 meters below the bed of the River Po. It was successfully completed in 1910. Domenico Borini had moreover maintained a long-standing relationship with Società Nazionale Officine Savigliano (SNOS) going back to 1884, thanks to which he had extended his skills from brick structures to those in reinforced concrete, and culminating in his expertise with the pressurized-caisson method.[25] In the early years of the 20th-century, the Borini Company had achieved international fame in this field. According to the memories of the family's heirs, Domenico Borini had received an invitation from the Siamese Government to take part in the bid for tender for the construction of the foundations of the Throne Hall. However, "there had been problems of extreme complexity in terms of execution as well as management and administration, and the Borinis decided not to present the bid."[26]

10 March 1908, the Société Anonyme de Fondations par Compression Mécanique du Sol or Compressol was in Bangkok to begin the construction of the 500 foundation posts sunk to a depth of about 12 meters **(fig. 1)**. These pilings were subsequently to be "tied together and strengthened by powerful reinforced-concrete *gemelle* designed by Maison Hennebique."[27] Emilio Giovanni Gollo, the engineer, was in Europe at the time but was "expected to arrive by the end of May. The French team is working on the foundations of the Hall, but we still do not know whether the famous posts will remain stable or whether they will sink into the deep […] the engineer Moreschi[28] is supervising the works in reinforced concrete being built by the French."[29] In May, more reinforced-concrete engineers and building contractors arrived from Italy[30] and on November 11, 1908, the first foundation stone was laid, with the name "Compressol" engraved on it. According to the engineer Carlo Allegri, after two years of work, "our monthly measurements of the levels began to report […] sinking of the foundations […]. Gollo quickly designed and installed a new system of foundations, during an adverse season characterized by the seepage of water into the subsurface, demolishing all or part of the new posts. […] Tall, waterproof caissons made of reinforced concrete were installed under every part of the building. These were connected with suitable passages so that the Hall, on which

work never stopped, floated on the awful land that the Compressol posts had failed to cross completely in order to reach the bedrock."[31] Emilio Giovanni Gollo applied the principles of a foundation system that, once again, was part of a construction culture studied at Polytechnic and consolidated in Turin by the Borini company's business. In Bangkok, the team from Turin shared knowhow with Société Compressol which, was using "des caissons évidés en vue de ne pas depasser le coefficient de travail du sol qui avait été fixé à 700 gr par cm^{2}"[32] in the construction of bridge over the Kong Mahanak the same year, 1908.

Figure 1: Some pictures of the Throne Palace building site in Bangkok, Thailand.

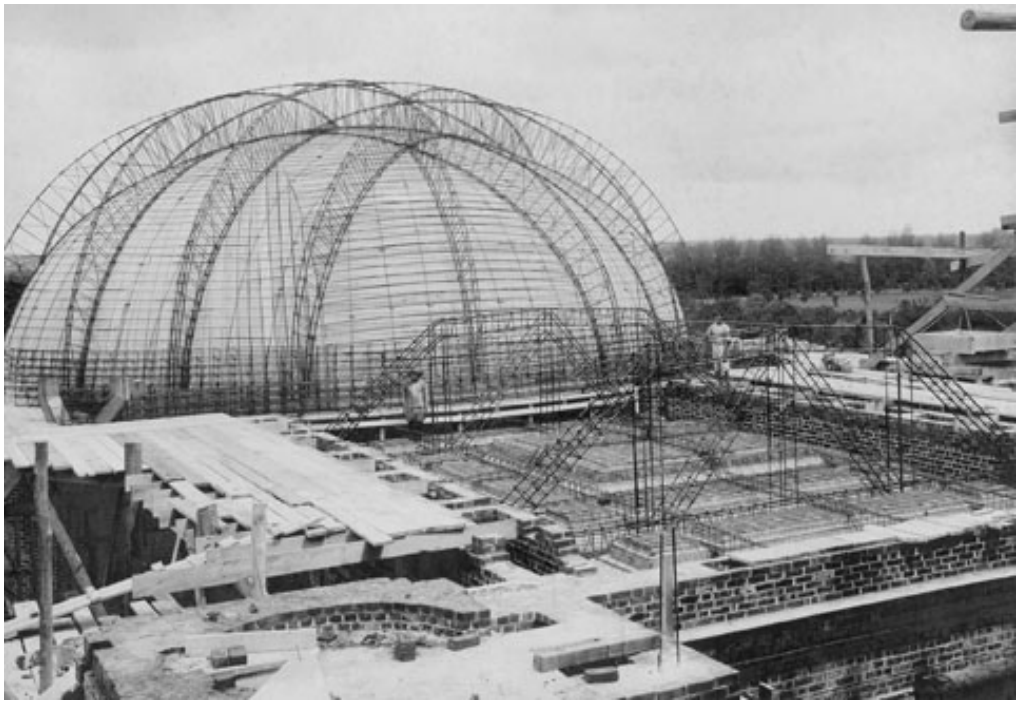


Source: *Le Problème des fondations dans les constructions et les travaux publics (Système Compressol)*, Paris, 1908, p. 42.

11 The relationship developing between Italian and French builders working on the Throne Hall project and other sites in Bangkok coincided with the peak of Turin's prominence as the most

active Italian city in the debate on and experimentation with the Hennebique and Compressol systems. With Italy preparing to celebrate the fiftieth anniversary of its national unification (1911), in Rome, Borini, Société Compressol and the company owned by the engineer G. A. Porcheddu were busy with one of the most daring building sites in the history of reinforced-concrete construction: the single-span Risorgimento Bridge, with its 100-metre arch **(fig. 2)**. The national semi-centennial was celebrated in Turin with an Industrial Exhibition. Borini, Compressol, and Porcheddu, collaborating on works along the banks of the River Po starting in 1908, were so successful that they were the subject of a series of articles published by the journal *Le Béton Armé*.[33]

Figure 2: Reinforced concrete works in the Throne Palace building site, about 1911.



Source: Drusacco (Italy), Tamagno private archive.

12 In Siam, experimentation with reinforced concrete technique was also being applied to road and bridge construction. In the decades between the 1890s and 1920s, these public works became one of the symbols of the country's modernization. In honor of the Siamese participation in the International Exhibition held in Turin in 1911, Carlo Allegri boasted of the projects supervised by Italians working for the Siamese Public Works Department. The list included: 120 km of roads in the capital and 500 km of roads in the country, 100 bridges in Bangkok "made of wood, masonry, iron, and reinforced concrete, 8 to 16 meters wide, 5 to 24 meters of span" and 200 bridges throughout the country "made of wood or reinforced concrete, 3 to 8 meters wide, 5 to 180 meters of span." Although Italians consistently played a role in the construction of the infrastructures, their participation was limited to the works carried out by the Ministry of Public Works. After the 1890s reform of government organization that resulted in the creation of ministries on the Western model, the responsibility for civil works was shared between the Ministry of Public Works – who managed Post and Telegraphs, Railways, and Public Works – and the Sanitation Department, a branch of the Ministry of Agriculture until 1907. The latter was in charge of road and bridge construction. In 1912, the reorganization of the construction sector led to a new division of responsibilities between the Ministry of Ways and Communications, the Department of Fine Arts (Ministry of the Royal House), and the Construction Department (Ministry of Capital). In the regrouping of roles, the Sanitation Department remained under French influence, while the Italians were the undisputed makers and doers at Public Works. The two departments were assigned different types of structures. This division of duties seemed to correspond to a distinction between works with monumental or representative aims (Public Works) and those for purely infrastructural

purposes (Sanitation Department). The success of Italians in Siam was closely connected to the skills they demonstrated as stylists, bred by a culture of eclecticism exported beyond Europe at the turn of the 19th-century. Several examples of bridges built to Italian designs are still standing. Many are in wrought iron, and in Dusit Park, there are still some red iron footbridges stamped with the "Larini Nathan & C." trademark **(figs. 3 and 4)**.

Figure 3-4: A little iron bridge at Dusit Park in Bangkok, Thailand.

The construction year (1902) and the firm of the Italian company who built it (Larini, Nathan & C.) are still visible.
Source: Francesca B. Filippi.=

13 Considerable opportunities for further experimentation seemed to be available in the early 1900s with the design of several wooden bridges outside Bangkok. These projects were supervised by engineer Edmondo Roberti di Castelvero, another graduate in civil engineering from the School of Application for Engineers in Turin **(fig. 5)**.

Figure 5: A wooden bridge outside Bangkok, Thailand (not better identified) by the engineer Edmondo Roberti di Castelvero.

Source: Rome (Italy), Roberti private archive.

14 Carlo Allegri reports that two of these bridges were "all teak wood, with connections, joints, plates, and bolts made of iron": a two-span bridge (sixty meters each) built on the river Me Ping Nacom in Lampang and a three-span bridge (sixty meters each) in Chiengmai. On the

latter, di Castelvero corresponded with Emilio Giovanni Gollo to resolve technical difficulties, exchanging sketches and details concerning the joints between the wooden beams. Emilio Giovanni Gollo mentioned an iron bridge over the river Menam (weighing over 2000 tons), built in 1905 using the same cantilever system as the Forth Bridge near Edinburgh.[34] The most famous Italian bridges, however, are the monumental spans built in Bangkok: the Makkhawan Rangsan, 1900-1 **(fig. 6)** and the Phan Fa Lilat, 1907 **(fig. 7)**, along the road linking the ancient royal citadel and Dusit Park. They made a pleasant urban vista out of the crossing from the inner-city area to the suburb. Designed by the Turin architect Mario Tamagno in collaboration with the chief of the Public Works Department Carlo Allegri and the engineer Emilio Giovanni Gollo, the two bridges were elaborately decorated with marble pylons, wrought-iron railings, and lampposts. Eclectic in style, they combined the neo-classical and massive monumentality of the stone pylons with the lightness of art nouveau flourishes like the floral details on the railings. Unfortunately, although we searched thoroughly, we failed to uncover documents proving which companies were involved in the construction of the Italian-design bridges. Likewise, it is impossible to analyze such aspects of the structural design as the foundations, for example. Despite the politically favorable climate, the Italian companies were apparently unable to establish a significant commercial network in Siam, partially due to a lack of support from the Italian government.[35]

Figure 6: The Makkhawan Rangsan bridge, Bangkok, Thailand (1900-1901).

On the Ratchadamnoen Road connecting the ancient Royal citadel with the Dusit Park.
Source: Drusacco (Turin, Italy)Tamagno private archive.

Figure 7: The Phan Fa Lilat bridge, Bangkok, Thailand (1907).

On the Ratchadamnoen Road, connecting the ancient Royal citadel with the Dusit Park.
Source: Drusacco (Turin, Italy), Tamagno private archive.

15 With the arrival of Compressol in Bangkok for the construction of the foundation posts of the Throne Hall and the signature in 1907 of the treaty between France and Siam, defining the long-contested boundaries between Siam and Cambodia, French reinforced-concrete companies were able to broach the Siamese market. Their success and spread were also supported by the assignments received by other Frenchmen operating within the Sanitation Department. Suppliers and consultants to help with carrying out the works were also found through French networks of professionals and companies in France or in Cochinchine. The presence of an "Indochinese connection" proved the complexity of the channels of a colonial economy driving the flow of European cultures, businesses, and goods in South East Asia. Trade between Siam and Cochinchine was guaranteed from 1896 thanks to the Messageries Fluviales de Cochinchine. Indochina supplied much of the cement imported by Siam (a quantity of 16,000 tons a year by 1910).[36]

16 Attesting to the rivalry between the French and Italians, the journal *Le Béton armé* prefaced its presentation of the projects implementing the Hennebique system in Siam by specifying that the French engineers of the Sanitation Department were independent from the Italians working at the Dusit Park, "who work for a different department, headed by an Italian engineer."[37] The rigid distinction deriving from the division of duties within the government also corresponds to a quite marked difference in the attitude of French and Italian professionals towards the introduction into Siam of the reinforced concrete technique. This divergence is evident from the documents relating to the French reinforced concrete bridge selected by King Rama V for the 1908 celebrations of the kingdom.[38] It was to be located three kilometers from Bangkok; to be built over the Klong Mahanak, it was made using the Hennebique system and measured a span of 22 meters **(fig. 8)**. The project was carried out by the Societé Anonyme de Fondations par Compression Mécanique du Sol on behalf of the City Engineer Robert de la Mahotiére and was part of a larger assignment to the Societé Anonyme de Fondations par Compression Mécanique du Sol which included two other bridges: one over the Rajadamri canal (with a span of 13 meters) and one on the Pache Chine road (with a span of 10 meters). To find materials and labor, Monsieur Bénabenq, a professional working in Bangkok for the Société de Fondations, suggested contacting neighboring Saigon. He praised the performance of the Indochinese cement,[39] emphasized its affordability, and advised his central office to order the materials for the bridge over the Klong Mahanak from suppliers in Saigon.[40] Moreover,

he requested that European workers skilled in reinforced concrete construction be hired in Saigon.[41]

Figure 8: Bridge over the Klong Mahanak, Bangkok, Richaud and Papa (1909-10).

Source: *Le Béton armé*, no. 144, 1910, p. 69.

17 Correspondence between the Societé Anonyme de Fondations par Compression Mécanique du Sol and the Hennebique offices in Paris mainly concerned the planning of foundations, complicated by two factors: the softness of the soil and the absence of a Compressol machine (it arrived in Bangkok later in 1908). With regard to the architectural design, in all three projects the French were careful to avoid eclecticism and the Italian style. They specified "no imitation, no stone, no bricks, no Italian style."[42] " The architectural design of the bridges will be modernist, appropriate to reinforced concrete construction, " wrote Mr. Bénabenq to the Societé Anonyme de Fondations par Compression Mécanique du Sol in Paris. In any case, the journalist writing about the bridge over the Klong Mahanak for "Béton armé" later pointed out: "The Siamese are very fond of decoration, but not the way the French generally understand it. They like artistic decorations. The King expressed a desire for this bridge to be ornamented lavishly. To satisfy this desire, the Société de Fondations had to order glazed stoneware decorations from France. It took four months for the supplier to deliver the pieces and, unfortunately, the ribbon was cut on the bridge before the structure had been decorated. Moreover, the pieces were broken in shipping, and we feared they would be unusable. The Siamese are artists, however: thanks to their patience and skill, we were finally able to mount the decorations. It took some trouble, but we were able to use the pieces for the effect we wanted from them."[43]

18 The first Frenchmen to begin doing business in Bangkok, alongside Compressol, were the Hennebique agents in Saigon, Richaud and Papa. They were among the few representatives in Asia of a company that could rely on a widespread presence in Africa and in the Americas.[44] Between 1909 and 1910, engineers Richaud and Papa were engaged to build two reinforced concrete bridges in cooperation with the Societé de Fondations: one in Bangkok, called "Pont du Siam," and another over the Klong Mahanak, outside the city. From a technical point of view, the bridge over the Klong Mahanak was the most challenging structure made by the French. All of the building had to be done by Siamese labor, because the Europeans had already left the country. The decoration was 100% reinforced concrete, but the structure was composite, with timbers "trapped in a layer of plain concrete 20 cm thick."[45] The slab and foundation were protected from corrosion by water with masks in reinforced concrete, built within cofferdams, which went down to three meters below the lowest water.[46]

19 In 1910, after only three years of activity, all traces of Hennebique and Compressol in Siam disappeared, although the Italian and French professionals recruited by the government continued to be active for another two decades. While there is no documentation regarding the construction firms involved in the projects carried out during this time and supervised by the Italians from the Department of Public Works, it is possible to see how the cooperation between Italian and French professionals continued over the years on certain projects requiring high-level technical skills. Certain projects the architect Mario Tamagno included in his list of the Siamese works[47] belong to this period. Five of them were designed in cooperation with French professionals: the Mansri bridge **(fig. 9)** on the Bamrung Muang Road, with F. Didier (1909); a bridge over the Lot canal, close to Wat Bunsiri (1916) and a bridge near the Wat Sudhat (1915), with engineer Belhomme; a bridge in the city of Nakorn Phatom (1918) and one over the Phitsathien Kut Mai canal in Bangkok with C. Baudart.

Figure 9: The architect Annibale Rigotti and the engineer Canova sit on the Mansri bridge.

Mario Tamagno architect in cooperation with F. Didier (1909).
Source: Drusacco (Turin, Italy), Tamagno private archive.

20 While the Throne Hall was under construction, a group of European and Siamese entrepreneurs suggested the formation of a society to promote the installation of a cement manufacturing unit in Siam.[48] The report presenting the company bears the signature of the engineer Emilio Giovanni Gollo.[49] Emilio Giovanni Gollo's career in Bangkok was also linked to a series of works that used reinforced structures to varying extents. Some of the constructions, like the reinforced concrete stands completed in 1922 for the Turf Club in Bangkok **(fig. 10)**, explore the formal potential of the new system. Part of a program expanding the King's private race course, they implemented protruding 8-metre beams, poured in a series on site and subsequently installed at the course. Even after Emilio Giovanni Gollo returned to Italy, his career as a specialist in reinforced concrete using the Hennebique system continued. In 1926, he appeared in court as an expert witness for the Porcheddu Company[50] in a lawsuit related to a tank the company built in 1912 in the Port of Tripoli (Libya).

Figure 10: The reinforced concrete seats of the Royal Turf Club in Bangkok, Thailand, designed by the engineer Emilio Giovanni Gollo (1921-2).

Source: Drusacco (Turin, Italy), Tamagno private archive.

The Società Nazionale Officine Savigliano and the Italian contribution to the introduction of metal construction in Siam by Vilma Fasoli

21 Italian architects, builders and engineers in Siam began fairly early to disseminate structures made of reinforced concrete construction according to the Hennebique[51] system, starting in 1907. However, in the field of steel structures, they worked less rapidly and extensively. Several scholars of Italy's economic history during its rise to industrial prominence have drawn attention to the difficulties encountered by the mechanical industry – and the steel industry along with it – in attempts to enter foreign markets. Throughout the period from 1871 to 1885, these endeavors, already slowed by domestic problems such as the rise in costs of raw materials and labor, were further hindered by the applications of customs duties which penalized Italian production, giving foreign companies an advantage. The legislation in force allowed foreign manufacturers to export awnings, iron bridges, and girders to Italy at half price.[52] The main Italian companies specializing in the construction of metallic structures in Italy during this phase were Impresa Industriale Italiana di Costruzioni Metalliche (hereinafter IIICM), founded by the engineer Alfredo Cottrau in 1870 in Castellamare di Stabia (Naples), and Società Nazionale Officine Savigliano (hereinafter SNOS) established in 1880 in Turin. They were both companies with a combination of Italian and Belgian capital. IIICM was backed by Finet Charles & Cie. of Brussels and, from 1889, had taken on the role of Italian agency for Eiffel folding bridges, while SNOS was backed by the company of Ernest Rolin, an industrialist from Braine-le-Comte and chairman of the Belgian metals and coal stock exchange. Relations between the two companies were fiercely competitive until 1898 when, with the death of A. Cottrau, IIICM closed. Until then, the international fame of the works created by this company and the numerous international awards given to A. Cottrau had overshadowed the activity of SNOS. From 1898, the production of SNOS was divided between two plants: one in Savigliano (province of Cuneo) specialized in the production of railway material and the construction of metal framing structures, and the other in Turin, linked to the electromechanical sector. The debut of SNOS on the foreign market dates back to 1883-1884, the year when it was commissioned to design and build the railway cars for the Compagnie Internationale des Wagons-Lits. In the field of framing metal structures, until just before the First World War, SNOS business had been limited to a couple of Mediterranean countries (Albania and Greece) or associated with Ernest Rolin's close relations in Central and Eastern Europe (Romania,

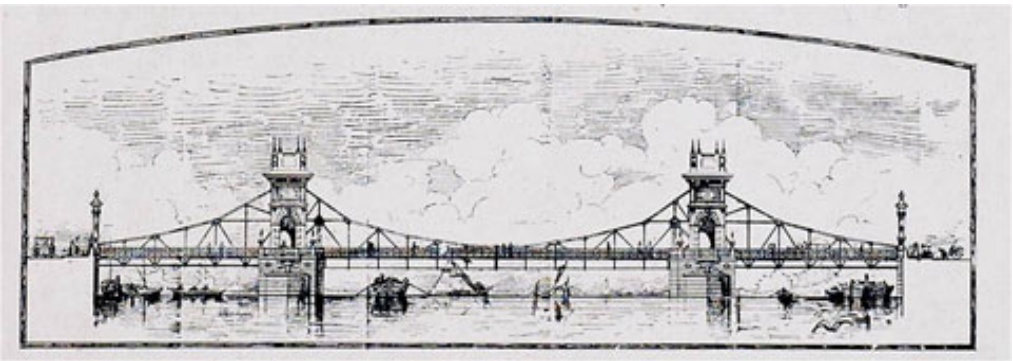
Bulgaria and Russia).[53] During the First World War, SNOS thrived, having won defense contracts linked to the supply of ammunition. In 1920, the reserves and amortizations set aside during the war[54] allowed an increase in capital (from 15 to 30 million Italian lire). The consistent profits made had been reinvested in perfecting and expanding the industrial structures, allowing a more marked diversification of SNOS products. From the early 1920s, SNOS was also committed to making changes in its business strategy, in an effort to limit its dependence on public commissions, felt to be risky due to the considerable delays with which the government respected the contractual agreements.[55] The company sought projects aimed at the international market, with openings extending beyond the Mediterranean countries to those of the Far East and South America.

22 This reform in business policy became effective in 1920 with participation in the tender for the construction of a rail and road bridge to be built in Siam over the Menam Chow Phja River.[56] SNOS offered the Siam Railway Ministry two options: one consisting of two separate bridges, side by side, and the other a bridge with a single span.[57] The following year (1921), the company participated in the bid for tender held by the Management of the Peking-Hankou Railway for the construction of the railway bridge over the Yellow River (China) **(fig. 1)**. The railway ranked the SNOS bid fifth, in a field of 63 foreign bidders. On subsequent occasions, such as the invitation to submit a bid to the Siamese railways in 1921 for the construction of 18 bridges (for a total of 1200 tons) or a 1924 call for tender issued by the International Commission overseeing foreign licenses in Tientsin (China)[58] for the construction of a new opening bridge over the River Hai-Ho **(fig. 2)**, SNOS achieved promising results. However, the company was not assigned the mandate for construction. SNOS had demonstrated its ability to convert experiences acquired in the military sector during the First World War into applications suited for use in civilian environments, and had developed greater skills in terms of promoting and advertising of its activity, publishing the journal entitled *Bollettino Tecnico Savigliano* in 1926. Nevertheless, it still faced fierce competition from other European firms with a longer history of operations in the Far East. By contrast, the high level of specialization it had reached in the construction of hangars for airships and seaplanes, of daring railway bridges, point equipment, pipelines and tanks for electric and hydroelectric plants, combined with ongoing friendships with representatives of public administration, facilitated business relationships with Latin American countries[59] and Egypt[60] at that time.

Figure 1: View of the bridge project on the Yellow River, China (1921).

Source: *Bollettino Tecnico Savigliano*, nos. 4-5, 1929, p. 220.

Figure 2: Bridge project can be opened in Tianjin, China (1924).



Source: *Bollettino Tecnico Savigliano*, nos. 4-5, 1929, p. 223.

23 So far, our research indicates that the bridge over the River Menam Chow Phja, built between 1929 and 1932 in Bangkok, is the only significant accomplishment of SNOS in the Far East. Its late arrival on the Far Eastern scene cannot entirely be blamed on the difficulties faced by the Italian government in supporting its businesses in more ambitious projects on the international market. Another factor was the strain to which the Kingdom of Siam was subjected by the colonial economic strategies pursued by Great Britain and France. Britain had been established in the territories west of Siam (Malaysia and India) for many years, and France had colonized the Indochinese peninsula. The two imperial powers had forced Siamese foreign policy to move with extreme caution. The pressure exerted by France[61] to draw Siam into its orbit, in competition with that exerted by Great Britain, which required more effective resistance, had ended in 1896[62] with the Franco-British agreement recognizing Siam's status as an independent kingdom. The Siamese government's work to develop the national rail network was a consequence of this agreement. From the economic and commercial point of view, the railway was a vital connection between the markets of Malaysia, served by the railway opened by the British in 1877, and the French markets in Indochina, reached by rail lines the colonial governor Paul Doumer[63] planned to improve and strengthen, starting in of 1897.[64] The experiences acquired by Italian firm SNOS prior to 1918 clearly put it in the minor leagues, underequipped to compete with giants like the French corporations Daydé & Pillé and the Eiffel Company, operating in Indochina, or the British Borneo Company Limited, which had begun operating in 1856 between the islands of Borneo, Singapore, and Hong Kong, in addition to having extensive operations in Siam. As of the 1920s, the relaunch of the works approved by the French government in Indochina had revived operations undertaken in 1892 to save the prestigious Eiffel Company from financial ruin in the wake of the Panama Canal scandal.[65] From 1893, work had been carried out in Indochina to ensure important commissions to the new Société de Constructions de Levallois-Perret, set up after Eiffel's resignation from the Board of Directors. In 1922, having survived the recession generated during the war by the rise in the price of iron, the new company had been assigned the construction of the 630-km railway line linking Saigon to the Siamese border.[66] Although the folding iron bridges invented and made by Eiffel had guaranteed the company the construction of most of Indochina's infrastructure up until then, in 1926 the government investment plan drawn up by Albert Armand Pouyanne,[67] chief engineer of public works in Indochina and inspector general from 1921, concentrated on adopting cheaper construction techniques, such as the use of reinforced concrete. In 1924, the management of Société de Constructions de Levallois-Perret converted Eiffel's traditional steel production to reinforced concreted, setting up a special department for works in Indochina. This decision prevented the French company from coping with the great recession of the 1930s. Conversely, the financial policy launched in 1926 by Italy, during the early years of Fascist government, had favored the stability of the currency and earned the confidence of the international banks, which readily made loans to big Italian companies. In a context of international economic stagnation, the financial reform guaranteed greater penetration of the foreign market by Italian companies and probably also strengthened the positions of SNOS in international tenders. The contract for the Phra Phutta Yodfa Bridge, also

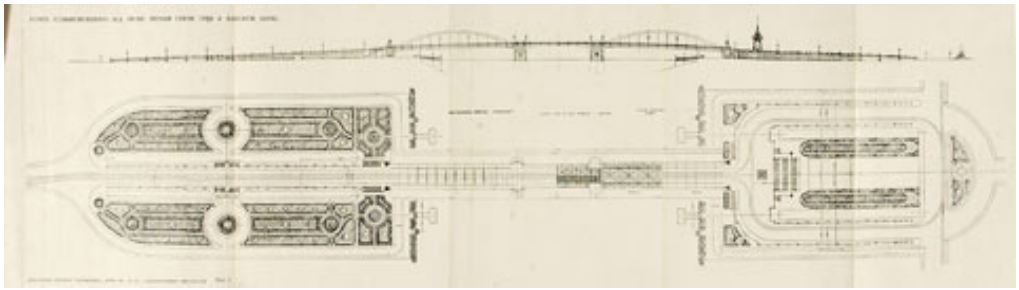
known as the Memorial Bridge, for which SNOS was qualified joint first with the prestigious English firm Dorman Long,[68] falls within this context. The tender for its construction was won by the English company but the Siamese government ordered that the works be carried out under the supervision of Italian technicians from SNOS. The archives of the Savigliano company contain a series of photographs documenting the on-site construction phases. They show that unskilled labor was recruited mainly at local level.[69]

24 This bridge is of particular importance, due to the two roles it plays. First, it symbolizes aspects of Siam's political and economic history. Secondly, it is outstanding due to the techniques employed in its construction. On one hand, it represents the final leg of the vast programmed for the transformation of Siam's transport system (from river to land, with a road and rail system) launched by the kingdom in 1863.[70] On the other, its construction continues a tradition that began in 1894, when King Rama VI decreed that a new bridge would be built to celebrate every anniversary of the Chakri dynasty.[71] The ribbon was cut on the Memorial Bridge, on April 6, 1932, and the statue of Rama I, [72] founder of the Chakri dynasty, was unveiled. The event marked not only the commencement of celebrations for the 150th-anniversary of the Kingdom of Siam, but also the start of the uprising that, several weeks later (24 June 1932), would lead to the outbreak of the Siamese revolution, the coup d'état, the formation of the first constitution and the voluntary exile of king Rama VII. When the dynasty's anniversary celebration was being planned, back in 1928, the Siamese government had issued call for a tender inviting Great Britain, France, Belgium, Germany, Sweden, the United States and Italy to make bids. The documents imposed two main requirements: the bridge could not interfere with the navigability of the river, and the structure had to be monumental in nature. A staff of SNOS engineers had travelled to Bangkok to survey the site, and to study the materials available, the organization of the site, and the recruitment of local labor. These initial inspections immediately revealed huge difficulties, including the feeble load-bearing capacity of the marshy land, a strong river current, and the river's depth (about 20 meters). For these reasons the company designed a bridge with a span of 228 meters and a weight in iron of 1430 tons, supported by two hollow pilings made of reinforced concrete **(figs. 3 and 4)**.

Figure 3: Projet of Memorial Bridge on the Menam Chow Phja River at Bangkok.

Detail Table. 1, June 1929.
Politecnico di Torino (Italy), Biblioteca Centrale di Architettura, Fondo Savigliano, 11203.

Figure 4: Memorial Bridge on the Menam Chow Phja River at Bangkok, (1929).



Source: *Bollettino Tecnico Savigliano*, nos. 4-5, 1929, p. 232.

25 The proposed structure would neither block the heavy boat traffic on the river, nor interfere with the flow so much as to expose the flat banks to the risk of flooding. To strengthen and stabilize the bridge support pilings, it became necessary to construct reinforced concrete foundation posts which went down to a depth of 30 meters below the water level. For this phase of construction, we are fairly sure there was a close collaboration between SNOS and the Fratelli Borini Construction Firm,[73] endowed with extensive experience in the construction of foundations using the compressed air caisson system. From the time of its founding, up to 1903, SNOS built over 180,000 cubic meters of foundations using this technique and produced

tanks with a total of approximately 6000 tons of iron. To meet the needs of the tender, the Italian engineers had drawn up an overall plan which, in addition to the bridge, included work on the river banks, roads and access ramps because **(figs. 5, 6 and 7)** "The arrangement of the masses and their proportions had to harmonize with the architectural lines of the bridge, blend in with the local style and enhance the commemorative monument that was to be erected on the access from the eastern side."[74]

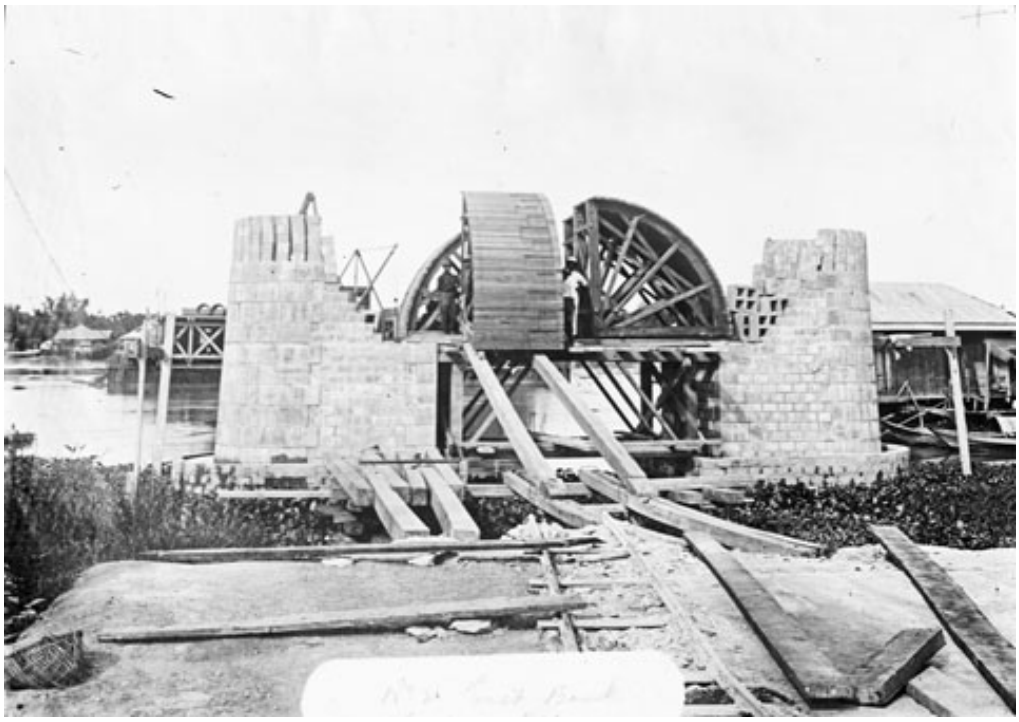
Figure 5: Excavations and pipe laying foundations for compressed air in the Menam Chow Phja River at Bangkok, Thailand.

Source: Turin (Italy), Politecnico di Torino, Biblioteca Centrale di Architettura, Fondo Savigliano, 10943.1.

Figure 6: Works along the banks of the river for the site preparation for the construction of the Memorial Bridge at Bangkok, Thailand.

Source: Turin (Italy), Politecnico di Torino, Biblioteca Centrale di Architettura, Fondo Savigliano, 10943.2.

Figure 7: Construction of the ribs to the piers of the Memorial Bridge at Bangkok, Thailand.



Source: Turin (Italy), Politecnico di Torino, Biblioteca Centrale di Architettura, Fondo Savigliano, 10947.1.

26 The containing walls along the river supported a system of terraces which housed viaducts, connecting ramps, and gardens, and compensated for the differences in height between the bridge and the city streets. On the eastern side, in particular, the plan to erect a statue of King Rama I necessitated the incorporation of a large square, monumental staircase, and terraced gardens into the accesses to the bridge **(fig. 8)**.

Figure 8: Bird View of the Memorial Bridge at Bangkok, Thailand (1929).

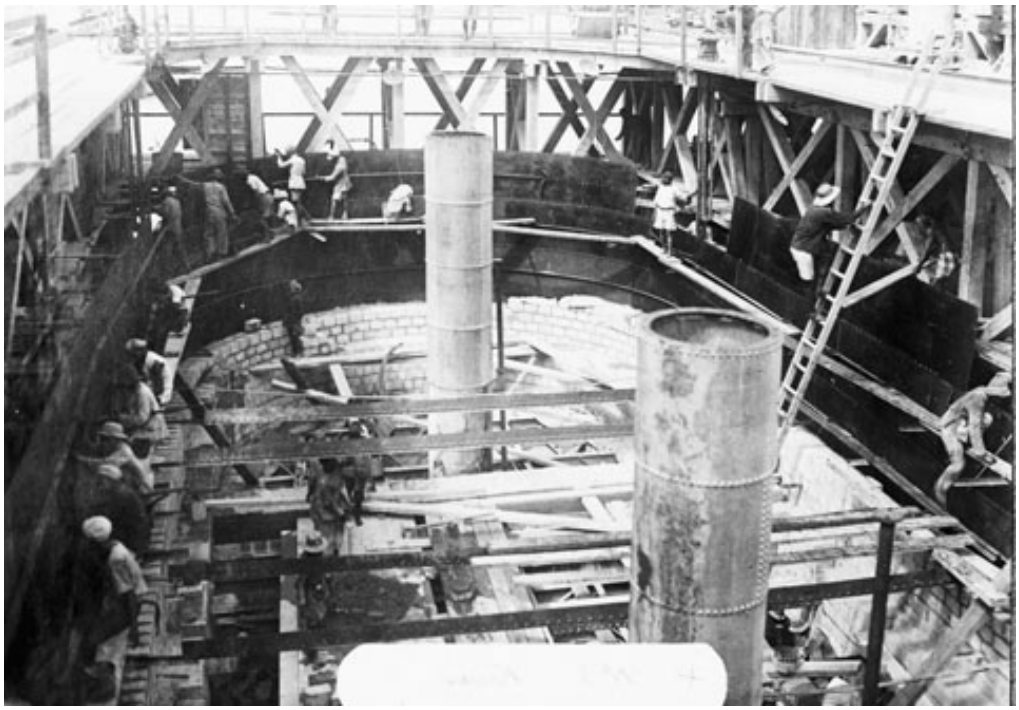
Source: Turin (Italy), Politecnico di Torino, Biblioteca Centrale di Architettura, Fondo Savigliano, 11203.

27 The new urban mall, centrally located and decorated with dynastic symbols, made it prime real estate for the installation of shops and businesses in all the available spaces of the bridge access viaducts. The use of reinforced concrete had been considered for all these structures and they had been calculated on the basis of the laws in force in Italy at the time **(figs. 9, 10 and 11)**.

Figure 9: Chests of metal prepared for the foundations of the piers of the Memorial bridge.

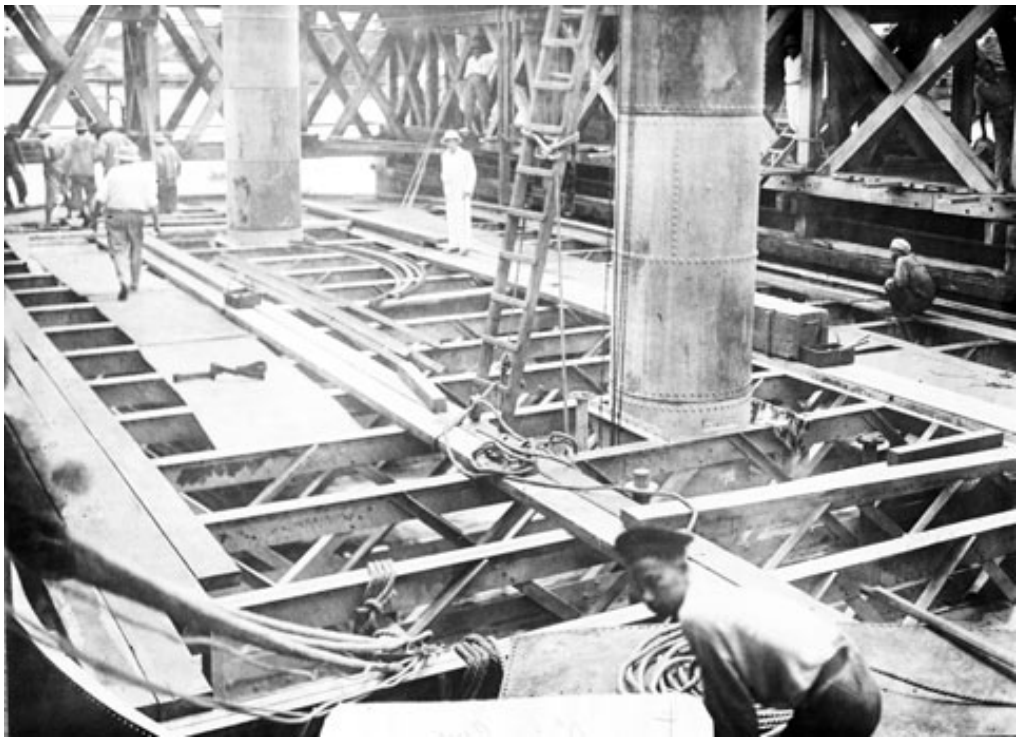
Source: Turin (Italy), Politecnico di Torino, Biblioteca Centrale di Architettura, Fondo Savigliano, 10947.2.

Figure 10: Construction of the masonry of the piers of the Memorial Bridge.



Source: Turin (Italy), Politecnico di Torino, Biblioteca Centrale di Architettura, Fondo Savigliano, 10947.2.

Figure 11: Construction of the Memorial Bridge during the completion of the foundations compressed air.



Source: Turin (Italy), Politecnico di Torino, Biblioteca Centrale di Architettura, Fondo Savigliano, 10948.2.

28 For the metallic structure of the bridge itself, SNOS had studied four possible alternatives, including a symmetrical revolving bridge (rejected because it was too expensive), an asymmetrical revolving bridge (rejected because the supporting pilings would have interfered with river traffic), and a lifting bridge (rejected because the lifting mechanisms would have been too expensive). The most cost-effective option turned out to be a drawbridge with two mobile arms which leaving a useful space of 42 meters for transit. Each arm was made up of six one-meter-thick solid-wall supporting girders, the weight of which was reduced by using high strength steel. The lateral spans would not have exceeded 85 meters with a maximum height of 11 meters and would have been built with solid tank walls to considerably reduce maintenance costs. The road level comprised space for two tram lines and pavements on the sides, with an overhang of 2.50 meters. Extensive commitment was required for the design of the lifting systems needed to open the central span of the bridge. These systems were based on electromechanical devices equipped with a series of controllers which activated warning lights and buzzers to guarantee simple, safe bridge maneuvers. Among the 18 projects presented, SNOS was assigned joint first place with that presented by Great Britain. Of the 23 executive designs and the technical report presented by SNOS, we have the reproductions published by the *Bollettino Tecnico Savigliano* in 1929 and several photographs taken during the site phases. For safety reasons linked to the considerable increase in road traffic, in 1983 the arms of the bridge were blocked. Since 2003, the bridge's structural integrity has been monitored by sensors **(fig. 12)**.[75]

Figure 12: Memorial Bridge on the Menam Chow Phja River at Bangkok, 2013.

Source: F. B. Filippi.

Notes

1 Francesca B. FILIPPI, *Da Torino a Bangkok. Architetti e ingegneri nel Regno del Siam*, Venezia: Marsilio, 2008 (Saggi, CRISIS, 5) particularly the chapter on the topic of Un cantiere internazionale: professionalità e imprese nel Palazzo del Trono (1907-16), p. 107-62; Vilma FASOLI, "The National Ironworks of Savigliano on the Mediterranean Rim," *in* Claudine PIATON, Ezio GODOLI, David PEYCERÉ (eds.), Arles: Honoré Clair, 2012, p. 30-3 and Vilma FASOLI, "Chantiers et entrepreneurs de constructions italiens au Maghreb: l'industrie Savigliano et l'entreprise Porcheddu," *in* Ezio GODOLI, Silvia FINZI, Milva GIACOMELLI and Ahmed SAADAOUI (eds.), *Architectures et architectes italiens au Maghreb*, actes de colloque (Tunis, Archives nationales de Tunisie, 10-12 december 2009), Firenze: Polistampa 2009 (Chemins de l'architecture italienne dans le monde, 2), p. 151-62.

2 The research was carried out within the scope of the project for international cooperation "ARCHING: ARChives d'INGénierie européennes" 2010-2012 and furthered in the course of the two Short Term Scientific Missions (2012 and 2014) pursued within the scope of the European project, Cost Action IS 0904 "European Architecture beyond Europe" (URL: http://architecturebeyond.eu.huma-num.fr/. Accessed 15 November 2014) coordinated by Mercedes Volait (InVisu, CNRS-INHA) at CNAM/SIAF/ Cité de l'architecture et du patrimoine/ Archives de l'architecture du XX^{e} siècle (Paris-France), Archives d'Architecture du XX^{e} siècle, Fonds Hennebique.

3 Guy LAMBERT, "Bridges as ambassadors: Hennebique's expansion in North Africa," *in* Claudine PIATON, Ezio GODOLI, David PEYCERÉ (eds.), *Building beyond the Mediterranean: Studying the archives of European businesses (1860-1970)*, Arles: Honoré Clair, 2012, p. 66-73.

4 Historians agree in identifying 1855 (Bowring Treaty, commercial treaty with Britain) as the symbolic date of the opening of the country towards the West. See: Walter F. VELLA, *The Impact of the West on Government in Thailand*, Berkeley, CA: University of California Press, 1955 (University of California publications in political science, vol. 4, no. 3); Fred W. RIGGS, *Thailand: the Modernization of a Bureaucratic Polity*, Honolulu, HI: East-West Center Press, 1965; Piyanart BUNNAG, "Problems of Westernization in Thailand: A Case Study of the Ministerial System (1892-1910)," *in* Charit TINGSABADH, *King Chulalongkorn's Visit to Europe: Reflections on Significance and Impacts*, Bangkok: Center for European studies, Chulalongkorn University, 2000, p. 47-59.

5 *Ibid.*

6 The most important participations were: Paris 1867, Le Havre 1868, Paris 1878, Antwerp 1885, Paris 1889, Chicago 1893, Hanoi 1902-3, Saint Louis 1904, Turin 1911.

7 After being crowned in 1868, King Chulalongkorn reigned until 1910 under the name of Rama V.

8 On the events linked with Dusit Park and the construction of the Throne Hall see Maurizio PELEGGI, *Lords of Things. The fashioning of the Siamese Monarchy's Modern Image*, Honolulu, HI: University of Hawai'i Press, 2002; Francesca B. FILIPPI, *Da Torino a Bangkok. Architetti e ingegneri nel Regno del Siam*, *op. cit.* (note 1); Francesca B. FILIPPI, *Palazzo del Trono Ananta Samakhom. Simbolo delle relazioni italo-thailandesi*, Bangkok: Amarin printing and publishin public, 2012.

9 The first School of Architecture in Thailand was set up in Bangkok in 1933 and it engaged the services of the architect from Turin, Ercole Manfredi. See B. A. FREEMAN, "Manfredi-architect of old Bangkok," *The Bangkok Post*, April 28, 1967.

10 The data is reported by Riccardo Motta in a letter to the Ministry of Foreign Affairs, Bangkok, Thailand, 1 February 1902, Italian Ministry of Foreign Affairs, Diplomatic Historical Archive, Rome.

11 Carlo ALLEGRI, *Relazione delle opere compiute dal 1890 al 1911 dal Dipartimento dei Lavori Pubblici del Siam sotto la direzione tecnica e artistica di italiani*, Turin, Officine Grafiche della S.T.E.N., 1911, Drusacco (Italy), Tamagno private archive,.

12 Camillo GUIDI, "Notizie sul laboratorio per esperienze sui materiali da costruzione annesso alla Regia Scuola di applicazione per gli ingegneri di Torino," *Annali della Società degli ingegneri ed architetti italiani. 2. Memorie tecnologiche e scientifiche*, 1895; Le costruzioni in béton armato, conferenze tenute nel maggio 1900 dall'ing. Camillo Guidi, professore di Statica grafica e Scienza delle costruzioni nella R. Scuola di Applicazione per gli Ingegneri in Torino, *in L'ingegneria civile e le arti industriali: periodico tecnico mensile per lo sviluppo ed il perfezionamento della scienza pratica e delle industrie nazionali*, vol. 26, no. 18, 1900, p. 273-9; no. 19, 1900, p. 289-95; no. 20, 1900, p. 305-11; no. 21, 1900, p. 321-8; no. 22, 1900, p. 337-43.

13 Riccardo NELVA and Bruno SIGNORELLI, *Avvento ed evoluzione del calcestruzzo armato in Italia : il sistema Hennebique*, Rome: AITEC, 1990.

14 Walter E. J. TIPS, *Gustave Rolin-Jaequemyns and the making of modern Siam: the diaries and letters of King Chulalongkorn's general adviser*, Bangkok; Cheney, WA: White Lotus, 1996.

15 From a letter written by Rolin-Jaequemyns in June 1899 to Swiss politician Numa Droz, see: *Ibid.*, p. 309.

16 The number of Europeans employed by the Siamese government is recorded in a letter sent to the Italian Ministry of Foreign Affairs by the consul in Bangkok Riccardo Motta the 1st of February 1902. See List of Italian subjects registered at the Italian Legation in Bangkok. Opposite the names of those engaged in the service of the Siamese Government is placed the name of the Department in which each is engaged, Italian Ministry of Foreign Affairs, Diplomatic Historical Archive, Rome.

17 Siam was reacting to France's move to annex Siamese territory on the eastern bank of the Mekong, in breach of the treaties signed by France and Siam in 1886. See: FRANCE. MINISTÈRE DES AFFAIRES ÉTRANGÈRES, *Affaires de Siam, 1893-1902*, Paris: Imprimerie nationale, 1902.

18 Letter of the Italian consul Riccardo Motta to the Ministry of Foreign Affairs, Bangkok, dated 4 January 1902, Italian Ministry of Foreign Affairs, Diplomatic Historical Archive, Rome.

19 Neungreudee LOHAPON, *Buon Fratello e Amico: Thailandia-Italia 140 anni di relazioni italo-thailandesi*, Rome: Amarin printing and publishing Co., 2010.

20 The Paolo Grassi private archive in Turin (Italy) has conserved several documents making it possible to reconstruct the family history. Gioacchino Grassi, from Capodistria, traveled to Bangkok as early as 1859.

21 Manfredo CAMPERIO, *Agenzie del Consorzio Industriale Italiano per il Commercio coll'Estremo Oriente*, Milan: U. Hoepli, 1898.

22 Gustavo STRAFFORELLO, *La Patria. Geografia dell'Italia: cenni storici, costume, topografia, prodotti, industria, commercio, mari, fiumi, canali, strade, ponti, strade ferrate, porti, monumenti, dati statistici, popolazione, istruzione, bilanci provinciali e comunali, istituti di beneficienza, edifizi pubblici*, Turin: Unione tipografico-editrice, [date unknown], p. 92-8. See also Claudio RENDINA, *Enciclopedia di Roma: personaggi, curiosità, monumenti, storia, arte e folklore della Città Eterna dalle origini ai nostril giorni. 2. D-L*, Rome: Newton Compton Editori, 2005.

23 Vittorio MARCHIS, *Domenico Borini (1861-1919): Un'impresa internazionale*, Turin: Centro studi piemontesi, 2013.

24 *Ibid.*, p. 63. At P. Gallotti's lecture on the technique in Paris, for the opening of the Exposition de l'Habitation housing show, October 22, 1903, it is illustrated as the Dulac system and was published as such in *Le Béton Armé*, vol. 6, no. 66, November 1903, p. 85-6. URL: http://lib.ugent.be/fulltxt/RUG01/000/895/607/RUG01-000895607-1903-066_2011_0001_AC.pdf. Accessed 15 November 2014. The subject is taken up again by P. OSSENT, "Procédé de fondation par compression mécanique du sol," *Bulletin technique de la Suisse romande*, vol. 26, no. 10, 12 avril 1910, p. 113 and no. 12, 25 juin 1910, p. 135.

25 See the contribution of Vilma Fasoli.

26 Vittorio MARCHIS, *Domenico Borini (1861-1919)*, *op. cit.* (note 23), p. 116.

27 P. G., "Le Béton armé et les Ponts au Siam," *Le Béton Armé*, no. 144, 1910, p. 67-9. URL: http://lib.ugent.be/fulltxt/RUG01/000/895/607/RUG01-000895607-1910-144_2011_0001_AC.pdf. Accessed 15 November 2014.

28 Berengario Moreschi, born near Mantua in 1874, graduated in Architecture and Construction Engineering and worked in Genoa in the early 20th-century. Luigi BRESSAN, "Ercole Manfredi: uno dei grandi architetti di Bangkok (1883-1973)," *in* Mahawitthayalai SINLAPAKON, *Italian-Thai studies : from the nineteenth century to the present : to commemorate the centennial of King Rama V's first visit to Europe : First International Conference, National Museum, Bangkok, November 19-23, 1997*, Bangkok: Silpakorn University; Maha Chula Bannakhan Printing House, 1997.

29 Rome (Italy), Private archive of the engineer Roberti. Letter from G. Kluzer to Edmondo Roberti di Castelvero, 28 March 1908.

30 The documents cite the engineers Olivieri and Eymard. See letter from G. Kluzer to Edmondo Roberti di Castelvero, 14 May 1908. Rome (Italy), Roberti private archive.

31 Carlo ALLEGRI, *Relazione delle opere compiute dal 1890 al 1911 dal Dipartimento dei Lavori Pubblici del Siam sotto la direzione tecnica e artistica di italiani*, *op. cit.* (note 11).

32 Pont Rajadamri à Bangkok, Propriétaire l'Etat du Siam, Concessionnaire La Societé de Fondations, 29 octobre 1908, CNAM/SIAF/ Cité de l'architecture et du patrimoine/ Archives de l'architecture du XX^{e} siècle (Paris-France), Fonds Hennebique, 76 IFA 1306/14.

33 *Le Béton Armé*, nos. 155-156, 1911. URL: http://lib.ugent.be/fulltxt/RUG01/000/895/607/RUG01-000895607-1911-155_2011_0001_AC.pdf and http://lib.ugent.be/fulltxt/RUG01/000/895/607/RUG01-000895607-1911-156_2011_0001_AC.pdf. Accessed 15 November 2014.

34 Emilio Giovanni Gollo's letter to Edmondo Roberti di Castelvero, Bangkok, 19 February 1904. Rome (Italy) Roberti private archive.

35 "Il commercio italiano, ora incipiente, si sta ampliando e tende a farsi strada con successo. E la questione di cui si tratta è appunto una questione di commercio. È questione di decidere se i commercianti italiani possano indegnamente e impunemente essere truffati dai commercianti siamesi. Se i commercianti italiani non vengono prontamente aiutati nelle loro giuste domande come potrebbe il commercio italiano continuare nel suo cammino? E con qual fede potrebbero le ditte italiane assumere imprese o lanciarsi in maggiori speculazioni senza la sicurezza che il Governo Italiano non è disposto a tollerare soprusi né ingiurie?" Letter from Riccardo Motta to the Ministry of Foreign Affairs, Bangkok, 27 August 1902, Italian Ministry of Foreign Affairs, Diplomatic Historical Archive, Rome.

36 Carlo ALLEGRI, *Relazione delle opere compiute dal 1890 al 1911 dal Dipartimento dei Lavori Pubblici del Siam sotto la direzione tecnica e artistica di italiani*, *op. cit.* (note 11).

37 "La décoration, exécutée entièrement en ciment armé a été étudiée par les ingénieurs français du service sanitaire chargés de la construction de ces ouvrages et dont le service est indépendant des travaux du Palais de Dusy, qui resortissent d'une administration différente, à la tête de laquelle est un ingénieur italien, tandis que les travaux des voies de communication sont confiés a des ingénieurs anglais," P. G., "Le Béton armé et les Ponts au Siam," *op. cit.* (note 27), p. 69.

38 "Mr. de la Mahotiére, Bangkok city engineer, told me it was urgent. Every year in early November, the King goes through the city, touring the pagodas. On these occasions, he always cuts the ribbon on a new structure, and this year he is going to choose Mahank Bridge, a 22-meter span yet to be built. The bridge must be finished by the end of October," Letter from Mr. Bénabenq to the Société Anonyme de Fondations par Compression Mécanique du Sol, March 29, 1908, CNAM/SIAF/Cité de l'architecture et du patrimoine/ Archives de l'architecture du XX^{e} siècle (Paris-France), Fonds Hennebique, 76 IFA 1306/14.

39 "For the cement, I am expecting price information from Ciment de l'Indochine. (…) Did Messrs. Richaud and Papa use it in Saigon? I have often used it for stonework, and it has never disappointed me," *Ibid.*

40 "If I need 15mm or 8mm iron bar, I can get it in Saigon," Letter from Monsieur Bénabenq to the Société de Fondations in Paris. July 2, 1908, *Ibid.*

41 "There are probably European personnel in Saigon who hav already been employed by Messrs. Richaud and Papa," Letter from Mr. Bénabenq to the Société par Compression Mécanique du sol, March 29, 1908, *Ibid*.

42 "The architectural design of the bridges will be modernist, appropriate to reinforced concrete construction. No imitations, stone, brick, or Italianate style, etc. The architectural plans, especially for the 22-metre bridge, must be carefully designed (see Mr. Binet's study for the Saints-Pères Bridge)," Letter from Mr. Bénabenq to the Société par Compression Mécanique du sol, March 29, 1908, *Ibid*.

43 P. G., "Le Béton armé et les Ponts au Siam," *op. cit.* (note 27), p. 69.

44 Christel FRAPIER and Simon VAILLANT, "The organization of the Hennebique firm in the countries of the Mediterranean Basin: Establishment and communications strategy," *in* Claudine PIATON, Ezio GODOLI, David PEYCERÉ (eds.), Arles: Honoré Clair, 2012, p. 35-43.

45 "Due to the unusually poor quality of the soil, and unable to make Compressol pilings because no materials were available, we decided to build pilings with mai kiern, a very hard, dense, rot-resistant wood." P. G., "Le Béton armé et les Ponts au Siam," *op. cit.* (note 27), p. 69.

46 "The basemat and foundation are protected from corrosion from the waters, which frequently undergo sudden variations, by reinforced-concrete masks that go down 3 metres lower than the lowest waters, built inside cofferdams. P. G., "Le Béton armé et les Ponts au Siam," *op. cit.* (note 27), p. 69.

47 Mario TAMAGNO, *Elenco cronologico di lavori compiuti dal prof. Mario Tamagno, Architetto, in proprio o in collaborazione con Ingegneri ed Architetti*, handwritten document, signed by the Royal Official of the Regia Legazione d'Italia in Siam, Bangkok 3 July 1926. Drusacco (Italy), Tamagno private archive.

48 Siam Cement Co. Ltd, The Siam Cement Co. Ltd., Bangkok, Publisher Siam Cement Co. Ltd, 1957; Siam Cement 1913-1983, Imprint Bangkok, 1983.

49 Emilio Giovanni GOLLO, "Report on Siam Portland Cement, 7 June 1909," cited *in* Ian BROWN, *Elite and the economy in Siam: c. 1890-1920*, Singapore: Oxford University Press, 1988 (East Asian historical monographs).

50 Politecnico di Torino, Dipartimento dei Sistemi Edilizi e Territoriali, Porcheddu Archive, different areas, Tripoli 1912-1913, dossier 4167.

51 Francesca B. FILIPPI, *Da Torino a Bangkok*, *op. cit.* (note 1), p. 107-62.

52 Ugo CARUGHI and Ermanno GUIDA, *Alfredo Cottrau, 1839-1898: l'architettura del ferro nell'Italia delle grandi trasformazioni*, Naples: Electa, 2003 (Napoli, uomini e luoghi delle trasformazioni urbane, 4), p. 50

53 Vilma FASOLI, "The National Ironworks of Savigliano on the Mediterranean Rim," *op. cit.* (note 1), p. 30-3

54 Ivan BALBO, "La Società Nazionale Officine Savigliano," *in* Sandro SOAVE (ed.), *Storia di Savigliano. Il '900*, Savigliano: L'Artistica Editrice, 2006.

55 Ivan Balbo states that "As early as 1918, the Board of Directors of SNOS pointed out how slowly it was meeting its commitments; despite contractual conditions "subjecting SNOS to considerable exposure of funds which now constitutes a serious sacrifice of interests" against which the company seemed to lack all defence." *Ibid.*, p. 199.

56 "L'attività delle Officine di Savigliano all'estero (executions and projects)," *Bollettino Tecnico Savigliano*, nos. 7-8, July-October 1929, p. 204 239 here in particular p. 232-8.

57 The first solution envisages a structure with five 90-metres spans made of simple triangle reticular girders (the end ones with one hinge and the central ones with two hinges) in such a way as to reduce the structural framework to the statically determined Gerber beam. The second solution consists of a single girder supported by round, hollow "towers" at least 3.5 metres in diameter.

58 In 1902, after the Boxer Rebellion, the Chinese Empire granted Italy the colony of Tientsin (now Tianjin). It returned to Chinese rule in 1947.

59 Its main clients were Empresas Electricas Associadas of Lima (1920) and La Companhia Electrosiderurgica Brasileira of Rio de Janeiro (1920-1921). Its most significant constructions were the Italian Pavilion at the Rio de Janeiro Expo (1922), the Argentine Air Force seaplane hangar (1928), and the Ago Bridge (between the island of Cobras and the mainland) for the Brazilian Navy (1929).

60 In Egypt, the SNOS built bridges over the Nile in Samanoud and Benha (1928) and the electrification systems of the Cairo-Heluan line (1929).

61 J. L de LANESSAN, *L'expansion coloniale de la France. Étude économique, politique et géographique sur les établissements français d'outre-mer*, Paris: Felix Alcan, Paris 1886.

62 Arnold WRIGHT and Oliver T. BREAKSPEAR, *Twentieth century impressions of Siam: its history, people, commerce, industries, and resources*, Bangkok; Cheney, WA: White Lotus Press, 2003.

63 Bernard LEMOINE, "Eiffel e il canale di Panama," *Casabella*, 1988, nos. 542-543, p. 88-95; Laurent WEILL, "Travaux publics et colonisation: l'entreprise Eiffel et la mise en valeur de l'Indochine (1889-1965)," *Histoire, économie et société*, vol. 14, no. 2, 1995, *Entreprises et entrepreneurs du bâtiment et des travaux publics (XVIIIe-XXe siècle)*, p. 292. URL: http://www.persee.fr/web/revues/home/prescript/article/hes_0752-5702_1995_num_14_2_1774. Accessed 15 november 2014.

64 Doumer's programme included a 1680-metre iron bridge (commonly known as Doumer Bridge), built over the Red River in Hanoi between 1898 and 1903 by the Daydé & Pillé company, later taken over by the Eiffel company.

65 Laurent WEILL, "Travaux publics et colonisation," *op. cit.* (note 63), p. 289.

66 *Ibid.*, p. 293.

67 A. A. POUYANNE, “Les travaux publics de l'Indochine,” *Société de géographie de Hanoi. Inventaire general de l'Indochine*, deuxième fascicule, Hanoi: Imprimerie d'Extrême-Orient, 1926.

68 The company was established by engineer Arthur Dorman and industrialist Albert de Lande Long after they bought the West Marsh Iron Works company in 1875. Jacqueline BEAUJEU-GARNIER, “L'Angleterre du nord,” *Annales de Géographie*, vol. 70, no. 377, 1961, p. 53-5 and Cassis YOUSSEF, “Grand patronat et performances économiques : l’Allemagne, l’Angleterre et la France au XIXe siècle,” *Histoire, économie et société*, vol. 17, no. 1, 1998, p. 139-56.

69 The SNOS photographic archives are divided between the State Archive of Turin and the Central Library of Architecture of Turin Polytechnic. The specific reference is to this second collection, which illustrates the on-site construction phases carried out by the company.

70 See here the contribution of Francesca B. Filippi.

71 The Chakri dynasty came to the throne of Siam in 1782. The first king belonging to this dynasty was Buddha Yodfa Chulalok, the Great – Rama I, who reigned from 1782 to 1809.

72 The statue was created by the Italian sculptor Corrado Feroci (known in Thailand by the name of Silpa Bhirasri).

73 Vittorio MARCHIS, *Domenico Borini (1861-1919)*, *op. cit.* (note 23), p. 21-52.

74 “Ponte commemorativo sul fiume Menam Chow Phja a Bangkok,” *Bollettino Tecnico Savigliano*, nos. 4-5, 1929, p. 237.

75 Kridayuth CHOMPOOMING, Wacharapong PRASARNKLIEO, Sayan SIRIMONTRI, Suphasit SIRISAK, “Structural Health Monitoring System of a Riveted Steel Truss Bridge,” *in* Fu-Kuo CHANG (ed.), *Structural Health Monitoring 2003. From diagnostics & prognostics to structural health management*, Proceeding of the 4th International Workshop on Structural Health Monitoring (Stanford, CA, 15-17 september 2003), Lancaster, PA: DEStech publications, 2003, p. 147-54.

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Résumés

Gegenstand dieses Essays sind die Beziehungen zwischen dem Königreich Siam und Italien von 1900 bis 1930, mit einem Schwerpunkt auf der zentralen Rolle italienischer Architekten und Ingenieure für die Einführung europäischer Kenntnisse und Technologien im Bauwesen nach Siam. Der allgemeine Kontext ist das bereits ausführlich beschriebene Phänomen der „kultivierten Auswanderung“, die ein wesentliches Segment der im Ausland tätigen europäischen Fachleute des späten 19. und frühen 20. Jahrhunderts betrifft. In diesem speziellen Fall jedoch haben wir im Exil tätige Italiener in Südostasien untersucht. Verschiedene Autoren haben in den letzten Jahren zu diesem Thema publiziert, wobei ein solides Gerüst für diesen Forschungsbereich noch aussteht. Die hier eingenommene Sichtweise ist europäisch. Europa ist nicht nur der Ort, an dem die Quellen für diesen

Forschungsbereich zu finden sind, sondern ist zusätzlich auch erster und wichtigster Schauplatz der sich durch die hier vorgestellten Projekte vermittelnden Baukultur, die hier erdacht und verstanden wurde. In diesem Artikel befassen wir uns nicht direkt mit dem vielschichtigen Problem des Aufeinandertreffens von italienischer und siamesischer Baukultur, sondern verfolgen den Export von zwei europäischen Bautechniken (Stahlbeton und Metalltragwerke, wie sie insbesondere im Brückenbau verwendet wurden) zurück und heben den Beitrag italienischer Architekten und Ingenieure hervor.

This essay discusses relations between the Kingdoms of Siam and Italy, 1900-30, focusing on the central role played by Italian architects and engineers in the introduction of European building knowledge and techniques in Siam. The general context is the extensively described phenomenon of “cultivated emigration” involving a significant segment of the European professionals working abroad in the late 19th and early 20th centuries. In this particular case, however, we have examined Italian expatriates in South East Asia. Several researchers have published papers on the subject in recent years, but a thorough framework for the study has yet to be set up.
The perspective chosen for the article is European. In addition to housing the source of the research, Europe is first and foremost where the building culture expressed by the projects analyzed here was forged and understood. In this article, we do not deal directly with the complex problem of the encounter between the Italian and Siamese building cultures. Instead, we have tracked the export to Siam of two European construction techniques (reinforced concrete and metal structure, especially as applied to bridge construction), emphasizing the contribution provided by Italian architects and engineers.

Este ensayo aborda las relaciones entre los Reinos de Siam e Italia, 1900-30, centrándose en el papel fundamental desempeñado por los arquitectos e ingenieros italianos en la introducción de los conocimientos y técnicas de construcción europeos en Siam. El contexto general es el fenómeno abundantemente descrito de «la emigración con alto nivel de formación» que implicó a un importante colectivo de profesionales europeos que trabajaron en el extranjero a finales del siglo XIX y principios del XX. En este caso concreto, hemos centrado el estudio en los italianos expatriados en el sureste asiático. Aunque durante los últimos años varios investigadores hayan publicado artículos sobre el tema, aún queda por sentar un marco de estudio bien definido. La perspectiva elegida para este artículo es la europea. Europa, además de albergar la fuente de la investigación, es ante todo el lugar donde se forjó y se comprendió la cultura de la construcción expresada en los proyectos analizados aquí. Este estudio no aborda directamente el complejo encuentro entre las culturas de construcción italiana y siamesa, sino que reconstruye la exportación a Siam de dos técnicas de construcción europeas (el hormigón armado y la estructura metálica, en especial para la construcción de puentes), destacando la aportación de los ingenieros y arquitectos italianos.

Cet essai évoque les relations entre le royaume de Siam et l'Italie entre 1900 et 1930 en se concentrant sur le rôle crucial des architectes et ingénieurs italiens dans l'importation de savoirs et de techniques de construction européens au Siam. Le contexte global est défini par le phénomène largement décrit de « l'émigration cultivée », impliquant une partie importante des professionnels européens actifs à l'étranger à la fin du XIX^{e} et au début du XX^{e} siècle. Dans le cas présenté ici, nous avons analysé le rôle des expatriés italiens en Asie du Sud-Est. Au cours des dernières années, plusieurs publications ont paru sur ce sujet, mais un cadre solide de recherche reste cependant à établir.
La perspective retenue dans le cadre de cet article est européenne. En effet, les sources nécessaires à cette recherche sont conservées en Europe, de plus, le continent européen est le premier et principal lieu où la culture du bâti telle que l'expriment les projets analysés ici ont été conçus et compris. Dans cet article, nous ne nous préoccupons pas directement de la question complexe de la rencontre entre les cultures architecturales italiennes et siamoises, mais nous étudions celle de l'exportation de deux techniques de construction européenne (à

savoir le béton armé et la structure en métal, notamment pour la construction de ponts) vers le Siam et mettons en lumière la contribution d'architectes et ingénieurs italiens.

Questo saggio tratta delle relazioni tra il Regno del Siam e l'Italia, tra il 1900 e il 1930, concentrandosi sul ruolo centrale giocato dagli architetti e dagli ingegneri italiani nell'introduzione delle conoscenze edili ed architettoniche europee nel Siam. Il contesto generale è il fenomeno, generalmente designato come « emigrazione colta », che vide una parte significativa dei professionisti europei lavorare all'estero tra la fine del XIX e l'inizio del XX secolo. In questo caso particolare, però, ci si concentra sugli emigranti italiani nel Sud-est asiatico. Molti ricercatori hanno pubblicato studi su questo argomento negli ultimi anni, ma senza poter fissare un quadro preciso. La prospettiva scelta per l'articolo è europea. Oltre ad ospitare le fonti della ricerca, l'Europa è soprattutto il luogo in cui la cultura edilizia espressa dai progetti qui analizzati è stata creata e compresa. In questo articolo l'autore sceglie di non affrontare direttamente il problema complesso dell'incontro tra le culture edilizie italiana e siamese, ma piuttosto di seguire la migrazione in Siam di due tecniche di costruzione europee (cemento armato e strutture metalliche, in particolare applicate alla costruzione di ponti), mettendo in risalto il contributo fornito dagli architetti e dagli ingegneri italiani.

Entrées d'index

Index de mots-clés : architecte italien, ingénieur italien, béton armé, structure métallique, échange transnational
Index by keyword : Italian architect, Italian engineer, reinforced concrete, metal structure, transnational exchange
Indice de palabras clave : arquitecto italiano, ingeniero italiano, hormigón armado, estructura metálica, intercambio transnacional
Schlagwortindex : Italienischer Architekt, Stahlbeton, Metallkonstruktion, Transnationaler Austausch
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