Conservation of 18th Century Java Industrial Heritage

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Abstract. Industries and trading have important roles in the development of the city. Sugar industries in Java developed by the Dutch were influenced by Industrial Revolution. Sugar trade worldwide was related to transportation that included train, railways and bridges and lately came to harbor. Industrial activities, such as industrial heritage, steam machineries, locomotives and carriages, railway heritage, bridges, and anything related to industrial culture played a critical role in Indonesia’s economic and social development that began in the late 18th century. The significance of study is that trade activities influenced urban development that also included architectural development. These activities generated a rich heritage of built structures, artifacts and records. But this heritage is at risk due to the growth and modernization of the Indonesian economy. Financial pressures result in the demolition of obsolete facilities located in urban areas, equipment is sold for scrap, and records are discarded. The purpose of the study is conservation of industrial building equipment and emplacement surrounded area. The method of the study was by historical method by tracing sugar history; agriculture, process of production, architectural record, trading activities and spread out of sugar industries in Java. Preservation of industrial heritage could play an important part in attracting visitors, as an alternative and complement to the island's more conventional tourists attractions.

Keywords: industrial heritage, archaeology and conservation

1. Introduction
The idea of the European continent on Enlightenment in the 17th century, industrialization in the 18th century and modernization in the 19th century simultaneously led to the colonization era. At the beginning of the 19th century European influence on trade management and the introduction of technology affected the world. This idea followed by Western European countries and also influenced the Dutch colonies in Java in developing agriculture and plantation industries, especially the sugar industry and the development of railroads for transportation to the port [1].

The ultimate creativity in the industrial revolution was the achievement of science in the form of technological change from human, animal or natural power. As a result of this technological change, the steam engine replaced human, and animal or natural power drove industrial machinery and transportation. The wider influence in the discovery of this new industry was to convert raw materials, mineral exploitation and agricultural products to produce a product for daily living needs.

Nowadays, the evidence of the above events is in the form of industrial buildings equipped with hydraulic engines and chimney burners which are symbols of the production process in 'space and time'. To transport raw materials to be processed from plantations and fields to industrial sites, manufactured materials were transported to ports for export using locomotives that pulled the carriages over long tracks.
Industry has an important role in economic, social and political development in the development of modern history of Indonesia. In the dynamics of the environment, the source of cultural inspiration certainly has economic value and shows the existence of a cultural heritage attraction. The legacy of cultural heritage presents itself as a tangible proof as an interest in the result of history relating to the object of the relic.

2. Methodology
This action research was carried out to understand historical potential agricultural land of Java sugar agriculture, Industrial agriculture of sugar, trading history of sugar and the consequence of 18 century Java Industrial architectural design in wider and more comprehensive means in the field of architecture. First, the writer as researcher defined and identified ground-theory by exploring data ‘Recording and Documenting Historic Structures’ archaeological research to find the original architectural shape and machineries, material of entire compound (emplacement, buildings and structure). After that, researcher reviewed architectural structure’s system in a more comprehensive approach, doing a structural benchmark of industrial building. Qualitative approach with logical explanatory was taken to explore this type of buidings, machineries and structure. Quantitative approach was previously conducted by most of researchers [2]. Furthermore the value of this Industrial Building was obtained by asking ‘What is the Significance of Historic Structures’.

3. Results and Discussion
The argument will be conducted in multiple aspect-specific subjects and arranged gradually so the connecting aspects would be seen in comprehensive approach. The starting point is understanding a variety of the original building shape which supports industrial architectural design, continued by study of elementary architectural structure. Afterwards, discussion about structure will be explained and applied conservation architectural design by deepen understanding conservation practical sense.

3.1. Industrial Archeology
The Industrial Revolution born in England in the 18th century was triggered by the discovery of the English scientist James Watt. His remarkable discovery was to convert the heated water vapor and then process it technologically into power that could drive the grinding machine, the locomotive engine and the ship's engine. It was this period that characterized the modern lifestyle, the agrarian transformation of society into an industrialist society in Western Europe. The Dutch community at that time brought the idea of the development of industrial technology steam engine to Java in the mid-18th century. They combined technology steam engine industry with the agricultural industry (agriculture) in Java. The coffee, tea, rice, tapioca and sugar industries were developed at that time. The peak of the Dutch East Indies economic development was the introduction of the system of forced cultivation.

The modern spirit of the Dutch State provided a remarkable development of industrial development, the discovery of various sources of energy for machinery, the intensification of capitalism and the intensive colonialism into modern imperialism. The most spectacular result of the industrialization was that Java, together with Cuba, became the world's largest supplier of sugar. After the abolition of forced cultivation many sugarcane and sugar industry plots fell into private hands (private). With this modern regulation the sugar industry became a seedling of capitalism [3]. This heritage which later gave prosperity to the Dutch people on the side of the Javanese society because of the System of Cultivation. Although the Cultivation System was abolished in 1870 but sugar cane as a raw material for sugar and coffee making industry was still in effect because sugar and coffee were very profitable commodities of Dutch trade.

Industrial Archeology is a branch of science that sees a period of history in which humans use technology as an important means of life. Against the cultural heritage of Java industry, there is a need for proper handling so that we can save the archaeological sites of great importance and the history of the machinery industry in the form of the development of steam engines, diesel engines and electric power machines [4]. The development of Archaeological Sciences in western Europe and the
United States today is not only concentrated on the site of medieval sites (15th century) and earlier but also oriented to the relics of the 18th century. Industrial archeology growing in Western Europe is a branch of archeology that studies the site industrial in the 18th - 19th century in the form of factory driven by steam engine. Archaeological Sciences of the industry is not only about industrial problems in the form of factory buildings but also facilities and infrastructure related to industries such as railway transportation, railway stations, irrigation systems, bridges and so on (Figure 1 and Figure 2). So Archaeological Sciences is a combination of Archaeological Sciences, Conservation, Architecture, Civil Engineering, Mechanical Engineering, History, Economics and Culture. Now even an international association has been formed for the conservation of industrial buildings as TICCIH (The International Committee for the Conservation of the Industrial Heritage) which often holds international discussions and seminars. The development of industrial archeology has had many results. In former Western Europe the former industrial area is conserved to serve as a tourist destination, the object of a former industrial building has a new function as museums, art galleries or other new functions appropriate for economic development. In the small town of Saltaire near Leeds, England many industrial buildings are still equipped with chimneys made office and apartment prestigious (Figure 1). Trains with locomotives with steam engine power are turned on again as an attraction for tourists. In France some ancient railway stations were made into museums [5].

3.2. Sugar Industry Cultural Heritage in Java
The development of sugar in Java was strongly supported by the climate and soil in Java which was suitable for sugarcane. Besides that, after the Industrial Revolution in Western Europe, the Dutch brought a form of steam engine technology that could move the milling industry on a large scale in Java. Sugarcane farming areas in Java are found in Central Java and East Java. The best climate for sugarcane cultivation is a hot area and enough rainfall. Noted in the map 'Suikerfabrieken op Java', sourced from Cartography. Inr. J.H. de Bussy, Amsterdam 1914 stated that in that year there were 191 sugar factories active in production, while from the map of 'Kaart der Suikerfabrieken, Spoor en Tramwegen van Java en Madoeira, Bijgewerkt tot 1 June 1925 also from Cartography source. Inr. J.H. de Bussy, Amsterdam, on the map shows in Java in 1925 there were about 201 sugar factories that were actively producing. The sugar industry played an important role in changing the economic tradition in Java from the agricultural economy to the mechanization of the economy in the period
1880-1955. In the mid-19th century after the mechanization period of the sugar industry the position of sugar production in Java rose to the best compared with other agricultural and plantation products. In the mid-18th century Java became the world's largest supplier of sugar in competition with Cuba and the results were still felt during the independence period until the 1970s [6].

From the sequence of events above, the sugar factory in Java is recorded as a heritage of the Javanese, Chinese and Dutch communities that are now agreed as 'shared heritage' or 'mutual heritage' [7]. Sugar mill factory grew in line between Cirebon to Kudus area which at that time was built transportation means in the form of transportation line for the purpose of trade in the form of famous railway with the nickname 'Golden Road' to connect the area of sugar-producing areas, such as sugarcane farm and sugar mill factory so that with easily transported sugar for export through the port of Semarang. Office of administration office to operate sugar production and trade mostly exist in Semarang Old Town which was the forerunner of Semarang city development [6].

The legacy of the sugar industry in Java, which is 1 ½ centuries old now is slowly threatened with extinction. The process of decline in the sugar industry in Java began in about the 1920s when Mount Merapi erupted causing the building of many smashed sugar factories, around Yogyakarta – Surakarta. There were about 15 sugar factories collapsed due to earthquake such as PG. Medarie, PG Kedaton Pleret, PG. Gedaren, PG. Gedoeng Banteng, PG. Gesiekan, PG. Demak Idjo and PG. Ngelom that no longer existed, only rubble debris or the name of the area. While some sugar factories that still existed until now around Yogyakarta and Surakarta only PG. Mojo in Sragen, PG. Tasik Madu in Surakarta (Figure 3) and PG. Gondang Baru in Klaten while PG. Cepear near Klaten and PG. Colomadu in Surakarta no longer reproduced. Then a recession in 1930 hit the sugar industry in Java, known for the “malaise” era where many factories were closed and destroyed [1]. Since the Second World War Java was under Japanese rule and many Dutch people returned to the Netherlands the fate of an sugar mill was erratic. After the independence of the Republic of Indonesia there were roughly about 50 of the remaining sugar mills. After the rehabilitation period the machines of the industrial sugar factory began to recede in the period between 1970-1998. Since the economic crisis of 1998 many sugar industry dismissed its operation due to costly production cost.

The sugar factory is a witness to the history of economic development during the industrialization period in Java which gave many advantages not only to the Dutch East Indies colonial government in Java but also the government of the Republic of Indonesia after independence until the mid 1970s. The Dutch industrial heritage is not only 'tangible' (factory buildings that are physical buildings, machinery and locomotives and lorries) (Figure 4), but also 'intangible' (i.e. non physical system of intangible) that is cultivation system of sugarcane farming and technology the process of making sugarcane into sugar. In addition, regarding the forced cultivation system to obtain raw materials in the form of sugarcane, farmers were forced to plant the plants determined by the VOC as the ruler. Farmers as owners and processors of land were forced to plant sugarcane on 1/5 of their land. This system survived even though Indonesia became independent and the sugar factory was under the Ministry of Prosperity of the State Sugar Company Administration (Badan Penyelenggara Perusahaan Gula Negara - BPPGN) in Yogyakarta.

3.3. Cultural Heritage Preservation
In its process, conservation is always questioned "What is the significance of the object(s)", what is the importance of the object to be preserved [8]. In the age of more than one and a half century sugar factories had the value of importance to be preserved as a cultural heritage (Benda Cagar Budaya). The Law on Cultural Heritage 2010 states that cultural heritage objects are a cultural richness of the nation which is essential for the understanding and development of history, science and culture, so it needs to be protected and conserved for the sake of the nation's awareness of national identity and national interests. Maintaining the preservation of cultural heritage objects required regulation steps that are useful for the protection, maintenance, management, utilization, and supervision of cultural heritage objects. From historical data it can be understood that sugar has an important meaning and meets the above criteria not only the history of economic development but also the history of port development and the history of urban development (urban morphology). Sugar factories also have aesthetic value as an architectural industry equipped with office and residence with colonial
architectural style. This is important for the scientific field of architecture and civil engineering to learn how to study architecture and structure of the past. In addition, sugar production used the locomotive as a means of transportation and machine engine with steam power technology which in its development was combined with diesel engine power engine and electric power. This unique and very interesting phenomenon can be developed for the benefit of not only tourism but also science in the field of machinery technology. In addition, the traces of sugar factory's history cannot be separated from the surrounding life of sugar cane farming which is an economic, social and cultural problem.

This event occurred again in economic recession of 1997-1998 where many sugar factories dismissed its operation. The 1997 economic crisis affected the shrinking productivity of sugar mills. At its peak about a dozen sugar factories were unable to operate again in Central Java. After the year 2000 even Indonesia began to import sugar to supply domestic needs. The closure of the post-crisis sugar factory had a very bad effect, firstly many people working in the factory had no jobs, including sugar cane farmers who had to think of planting other crops in the sugarcane field before. The third most serious problem was the closing production of many sugar factories because of less benefit of sugar production compared with importing sugar. As a result many facilities in sugar factories were damaged and decayed ranging from factory buildings, warehouses, office facilities, housing, and other facilities whose historical and architectural values were so high. They were not well preserved. There was much looting from elements of existing home materials, railroad trains to old iron machines that have historical value. In addition, due to heat and rain there is a lot of damage to the building because there is no treatment because there is no system to take care of it. This situation is ironic. On the one hand, many people need housing to reside and school as a place to study; on the other hand, the government let sugar factory uninhabited where the factory buildings and other facilities were gradually destroyed.

The remaining problems are about 40 more sugar factories still in production and dozens of other sugar factories that are no longer producing in Central Java and East Java under the coordination of PTP IX, X and XI. Production of sugar factories is highly dependent on the supply of sugarcane as the raw material for sugar production comes largely from sugar cane farmers. Now the quality of sugarcane is not as good as it used to be, the rendement is not good anymore because now the sugarcane farming process is not cultivated well, especially in Central Java. In addition, the land for sugar cane farming is also decreasing as farmers have moved to plant other plants that are more profitable. In East Java there are still many sugar factories in production, sugar cane is also still quite extensive and well cultivated. But in general the problem of the main sugar factory is the cost of production which often exceeds the price of the sugar product. If left unchecked this will result in the closure of the sugar factory slowly and we will lose the legacy of historical relics that are priceless. Alternative to tackle this problem should be considered together because the assets 'Industrial Archeology' in Java is already a global class. Furthermore, this sugar factory is a living museum whose existence is rare in this world. If this asset is well managed and thought together by the stakeholders then it is not impossible will give a positive outcome.

3.4. Sugar Factory Revitalization

Revitalization of Regions is an effort to revive a region by providing new functions to generate the vitality of existing and degraded areas and buildings but not yet fade through physical and non-physical interventions in the fields of economy, environmental management, heritage management, socio-cultural engineering and institutional development. According to Tiesdel in Revitalizing Historic Urban Quarters (1996) revitalization is: Improving the quality of the property to address certain dimensions of that property obsolescence. Owners and occupiers of buildings can address the dimensions of obsolescence that are within their abilities, especially the structural, functional and image dimensions. There are redevelopment, renovation and re-function. The Revitalization approach should be able to recognize and exploit the potential of the environment (history, meaning, location uniqueness and place image). With the support of revitalization plan control mechanisms, it should be able to raise the strategic issues of the region both in the form of social and cultural activities and economic and physical character of the region [9].
The existence of tourist areas for recreational facilities will provide economic sustainability to be able to support the existence of Gondang Baru Sugar Factory. The plan includes a museum of sugar that is passive and active for the benefit of education and preservation of cultural heritage in the form of sugar processing industry using 19th century technology in the form of steam engine. Revitalization of the area as an effort to save and preserve the area of Sugar Mill Tasik Madu Plant in Karang Anyar Surakarta previously owned by Mangkunegaran has been done by the PTP. The location of the emplacement is used as a tourist area while the sugar production process is still running. This activity contributes to the preservation of redevelopment, renovation and refuncon but the work of this process does not involve archaeologists, so that the value of authenticity decreases and many materials that are not original are replaced with new material.

Figure 3. Tasikmadu Sugar Factory Karang Anyar Surakarta.

Figure 4. Former sugar cane machine is placed in an open area as a sculpture for children’s playground.

Archeological principles in the implementation of conservation need to be introduced to the world of architectural and regional design:

**Minimum intervention:** As in Burra Charter Art.3, 1979, New Zealand Charter Art. 4.iii, 1992 which emphasizes that “conservation action is an act of intervention to historic buildings on the
level of building authenticity. Therefore, any intervention action on the grounds of research and technical action from the beginning should be kept to a minimum.

**Minimal loss of fabric:** As evident in Deschambault Declaration Art. V-C, 1982, New Zealand Charter Art. 4.ii, 1992 which emphasizes that "all conservation actions should take into account the original loss of building materials to a minimum."

**Riversibility:** As is evident in Burra Charter Art.1.10, 1979, Appleton Charter Art.D., 1983 which emphasizes that all intervention measures to historic buildings should refer to the possibility of broad future developments or remedial action on issues not yet seen where the originality of the source may be impaired.

**Legibility (clarity):** As written in Venice Charter Art.12, 1964, Burra Charter Art. 19-3, 1979 which asserts that "all new reimbursement of missing elements in historic buildings must be distinguished from the original to avoid counterfeiting of historical evidence.

Buildings in the factory area (emplacement) in particular the original residential buildings and elements of machinery and architecture are conserved by referring to the rules that have been established and revived. Steps that need to be done are as follows:

- **Recording - Documenting historic structures**
  
The historic original building is preserved by conducting the first historical exploration studies to show that the building has historical value so it needs to be preserved. Second, hold complete measurements and architectural reconstructions to record the original data of the building [10]. Third, reconstruct steam engine machines that still work both milling and locomotives because the machine is a rare item and priceless and will be the main attraction because of its uniqueness.

- **Improve environmental quality**
  
Facilities and infrastructure in the sugar factory area need improvement such as roads, drains, exhaust system which often cause problems of pollution in the surrounding environment.

- **Rules of rules in the preservation process**
  
Parties PTP and BPCB (Cultural Heritage Preservation Agency) representing the government should do conservation program with rules according to the rules of conservation right. Where necessary, any new material replacement should be done according to the correct rules [11]. The need for architecture data for the purposes of conservation for the authenticity of building buildings and machine engines that have this historical value awake authenticity. The government can also cooperate with universities and professional organizations, such as HAPBI (Association of Building Maintenance Experts) or IAI (Indonesian Architects Association).

- **Economic feasibility study**
  
Physical revitalization in the form of buildings, machinery and environment will increase confidence in the area, but to keep confidence to be maintained, there must be a revitalization in the field of economy. Tim Heath Tiesdel in his Revitalizing urban quarters proposes that 'Functional restructuring' new uses or activities of replacing the former ones; while 'functional regeneration' is an alternative to existing uses. Moreover, the change in building functionality will provide new alternatives to increase revenue [9].

3.5. **Conservation of 18 Century Java Industrial Heritage**

Industrial heritage in Java that include sugar, tea and coffee factories are part of our heritage. Economic history also recorded this heritage in relation to world trade. In the sense of trading history, the heritage included not only factory but also train railway and bridges to transport the product of tea, coffee from the factory to the harbor. All of the 18-century factories and all of their facilities, train railway bridges and harbor still exist in Java. Some of them are still in operating system. They have value in the sense of technological development, trading system and agricultural science in Java.

According to Government Regulation related to Heritage; Act no 11 year 2010 about cultural heritage is something handed down from one generation to next that has cultural value. 18th century Java sugar mills have historical, scientific, educational and cultural values included as cultural heritage.
1. **Conservation Program**: BPCB (Cultural Heritage Preservation Agency) representing the government should do conservation program with rules according to the rules of conservation right.

2. **Recording and Documenting**: The need for data, history, archaeology, architecture and structure for the purposes of authenticity of building and machine that have historical value.

3. **Revitalization**: To improve the economic level of sugar mills, a competitive development is needed for emplacement of sugar factories for better community life. One of which is the means of recreational and educational activities to bring the wheels of the economy up.

4. **Authenticity**: Conservation action is an act of intervention to historic buildings on the level of building authenticity. Therefore, any intervention action on the grounds of research and technical action from the beginning should be kept to a minimum.

5. **Improve Environmental Condition**: Environmental conditions that exist in the area of sugar factories are usually slum because a lot of goods in the form of ferrous iron had no place and then littered the area. They need to be arranged and maintained.

6. **Reversibility and Legibility**: All intervention measures to historic buildings should refer to the possibility of broad future developments or remedial action on issues not yet seen where the originality of the source may be impaired. All new reimbursement of missing elements in historic buildings must be distinguished from the original to avoid counterfeiting of historical evidence.

4. **Conclusion**

In fact, all sugar factories in Java are highly feasible to be able to revitalize both those that are still in production and that stopped. All stakeholders must support each other. Archaeologists should play a great role in this activity to preserve the value of the authenticity of industrial cultural heritage. The surrounding community will definitely support this effort if this revitalization has a positive impact for the surrounding community. The Pecangaan Sugar Factory near Jepara is one of the oldest factories in Java now still operating with other functions as a sack factory where at least the existence of the building can still be maintained. Revitalization of sugar factories is not only for tourist sites but also other facilities. For instance, the area of Sugar Factory Colomadu is no longer operable but it can be used as other facility where its machines can be stored in the museum. The Olean Sugar Factory near Situbondo East Java is a small but very attractive sugar mill. All facilities are still complete and original from factory building, housing, machine, locomotive along with its rail and old *munggur* tree.

If the revitalization is carried out correctly, it is not impossible that this area can be proposed to be 'World Heritage Industrial Site'. All can be done as long as 'no damage' in the sense of maintaining the authenticity of the area and the building of cultural heritage.

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