Using Information System Simulations and Modeling to Reconstruct Traditional Building Structures: The Case of Joglo Buildings in Indonesia

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Abstract

Today, information systems have begun to contribute to all aspects of life including conservation and management of heritage. In this context, this paper proposes what it calls a Reconstruction Information System of Joglo Traditional Building Structure (RISTBS) which aims to preserve architectural knowledge useful for people who still apply traditional architectural concepts in house constructions. This information system design uses the Software Development Life Cycle (SDLC) method through the stages of analysis, planning, prototype design, implementation, management, integration and maintenance of information systems.

Information system database requirements are a representation of knowledge of Joglo traditional building structures based on the hierarchy by type, structural reconstruction and structural elements of Joglo traditional buildings that are processed and displayed in the information system. The search method uses Best Fisrt Searching (BFS) search from branch to leaf sequentially until the desired knowledge is found.

This paper examines the development of an information system to reconstruct the structure of traditional Joglo buildings and generate data on the type, reconstruction process and structural elements of traditional Joglo buildings. Data is collected through direct observation to the object of research, interviews with sources and literature data.

The results achieved is a prototype information system that can be accessed by application-based users. Designing an information system is expected to provide information about the type, structural reconstruction and structural elements of traditional Joglo buildings.

Keywords: Information System, Reconstruction, Joglo Traditional Building Structure.

Introduction

Continuity of knowledge in the field of architecture can be seen from the relationship between the past and the present. The traditional building of Joglo is a priceless heritage of knowledge that needs to be preserved. They are in high demand by the Javanese community, reflected in the fact that there are still many new buildings that physically express joglo architecture. However, their cultural values have been partially lost.

Information technology is a technology that combines computing (computers) with high-speed communication lines that carry data, voice, and videos to help generate, manipulate, store, communicate, and transmit information (Williams & Sawyer, 2007). Needless to say that the development of information technology has caused a considerable revolution in human life.

Digital architecture is not only about drawing tools, presentation, planning, design, and communication with clients. It is the use of technology and information in the overall architectural planning and design process (Satwiko, 2009).

Globalisation provides space for architectural acculturations. Unlimited information available through globalization has changed knowledge about architecture in the past. Traditional Joglo buildings have meanings and messages when read by different people and times, and these meanings and messages become meaningless without an understanding of the past architecture (Budiharjo, 1991). Thus, the changes in the architectural values in traditional Joglo buildings are increasingly eroded along with the times.

This paper produces an information system that helps in the effort to reconstruct knowledge about Joglo traditional buildings as a whole. Titled 'Digital Documentation of Knowledge about Joglo Traditional Building Structures' it is an effort to save the knowledge of Joglo traditional buildings in the hope that Joglo architecture can be preserved properly.

Its objectives are as follows.

1. Create digital data of Joglo building types.
2. Create digital data to reconstruct the structure of the Joglo buildings.
3. Create digital data of Joglo building structural elements.

Theoretical Basis and the Approach

According to Haag & Keen (1999) information technology is a set of tools that help work with information and perform tasks related to information processing.

According to Marakas & O'brian (2017) a system is a collection of components that interact with each other to perform a task to achieve a goal. In any system, there are three basic components. They are:

- Input, entering raw data to be processed.
- Process, transforming input into output.
- Output, sending raw data that has been processed to the user.

Kusrini & Koniyo (2007) say that information is data that is processed into a form that is useful to the user. According to Gelinas & Dull (2012), an information system is a system based on a set of computer and manual components that can be collected, stored, and processed to provide outputs to users.

Marbun (1996) explains that reconstruction means building or restoring something according to its original occurrence, containing the main values that must remain in the activity of rebuilding something according to its original condition.

According to Banks & Carson (1984), Simulation is an imitation of a real system that is done manually or by a computer, which is then observed and concluded to study the characterization of the system. Law & Kelton (1991) define simulation as a collection of methods and applications to mimic or represent the behaviour of a real system, which is usually done on a computer using specific software.

Aditya (2007) explains that modeling is a process of forming a model that you want to create. Modelling is the initial stage of a series of drawing or animation processes before entering the next stages.

According to Frick (1997) Joglo architecture is a tangible manifestation of Javanese culture that functions as a dwelling. The structural system of a traditional Joglo building is

divided into three parts, namely the foot (foundation), the body (columns), and the head (roof). The structural system lies in resisting lateral forces through the central load of the building in the form of *saka guru* (columns) and *tumpangsari* (ceiling beam arrangement) called the *rong-rongan* structure. The structural elements of the building use wood materials with a knock-down construction system.

According to Ismunandar (1990), the way to construct a traditional Joglo building starts from the lower structural elements located in the northeast, southeast, southwest, northwest and so on until it ends at the upper structural elements. According to Ronald (2005), the orientation of the Joglo buildings is closely related to the north and south directions.

There have been many efforts to restore the architectural concept of traditional Joglo buildings, but in the midst of rapid technological development, no one has documented it in the form of a database. Knowledge-based systems are a part of artificial intelligence. According to Akerkar & Sajja (2009), knowledge-based systems are computer-based systems that use and generate knowledge from data, information, and knowledge. This system can understand information and make decisions based on the information or knowledge it stores. One of the results of knowledge-based information technology is an expert system.

Information System Requirement Analysis

The combination of information technology and architecture is an open mind to be able to identify problems, collect data, process data and design information systems (Hasan, 2014). In order to systematically describe the knowledge to be presented, it is composed of several components of the information system analysis. Data sets are grouped based on knowledge categories that are entered, processed, and displayed by the information system to reconstruct the structure of traditional Joglo buildings.

Analysis is needed so that the system to be designed can function consists of input requirements analysis, process requirements analysis and output requirements analysis. The main problem faced in designing an information systems is the identification of types, structural reconstruction and structural elements of traditional Joglo buildings. This analysis is carried out to facilitate the design of information systems.

Table 1: Input Requirement Analysis.
Source: Author.

Needs	Input
Types of traditional Joglo buildings.	Description of traditional Joglo building types.
Reconstruction of Joglo traditional building structure.	Knowledge of Joglo traditional building reconstruction.
Structural elements of traditional Joglo buildings.	Identify the structural elements of traditional Joglo buildings.

Table 2: Process Requirement Analysis.
Source: Author.

Needs	Manage
Data on traditional Joglo building types.	Add, delete, and modify Joglo traditional building type data.
Structural reconstruction data of traditional Joglo buildings.	Add, delete, and modify data on the Joglo traditional building reconstruction process.
Structural elements data of traditional Joglo buildings.	Add, delete, and modify Joglo traditional building structural element data.

Table 3: Output Requirement Analysis.
Source: Author.

Needs	Output
Traditional Joglo building type.	▪ Roof Arrangement ▪ Sector Arrangement ▪ Specific Structural Elements
Stages of reconstruction of traditional Joglo building structure.	▪ Reconfiguration of the structural elements of a traditional joglo building.

Structural elements of traditional Joglo buildings.	▪ Shape ▪ Material ▪ Dimensions ▪ Construction System ▪ Meaning

Table 4: User Requirement Analysis.
Source: Author.

User	Activity
Admin.	▪ Add, delete, modify Joglo type data. ▪ Add, delete, modify data on Joglo building structure reconstruction stages. ▪ Add, delete, modify data on joglo building structural elements.
Information Users.	▪ Searching for information on traditional Joglo building types. ▪ Searching information on the reconstruction process of traditional joglo structures. ▪ Searching information on structural elements of traditional Joglo buildings.

Subjects, Objects and Research Locations

The orientation of this research is to understand the types, reconstruction and structural elements of traditional Joglo buildings. The steps taken were to see and hear more closely the knowledge of traditional Joglo building structures. Data collection methods were obtained from field observations, both direct interviews with resource persons and direct observation of the object of research, and supplemented by literature data.

Research Methods

The research data was obtained in the form of a series of descriptions from the interviewees. The interview process was conducted by asking questions directly to the interviewees. Documentation of interview results in the form of voice recordings, photos and videos. The selection of sources was made according to their expertise, skills and credibility in relation to the data required. The results obtained are information about the shape, materials used, dimensions, construction system of the structural elements of the Joglo building. Direct interviews were conducted with Soenarto (culturologist), Warno Diharjo (construction expert) and Mirjo Miharjo (construction expert assistant) to explore the knowledge about the Joglo building structure. The criteria of the interviewees can be explained as follows.

Table 5: Data of Resource Persons.
Source: Author.

Person	Competence
Culturologist.	Have knowledge of traditional Joglo buildings.
Construction Expert.	Have skills and experience in traditional Joglo building construction techniques.
Construction Expert Assistant.	Sufficient and qualified experts in the field of traditional Joglo building construction.

The object of research is to obtain data more systematically (Dajan, 1986). Joglo comes from the words *tajug* and *loro* which means two mountains. There are four higher-sized poles that support the roof load, the four poles are called *saka guru*, which support and become a meeting place for the roof truss that supports the roof load. In accordance with its development, the traditional Joglo building consists of twelve types, namely: (1) jompongan, (2) *kepuhan lawakan*, (3) *ceblokan*, (4) *kepuhan limolasan*, (5) *sinom apitan*, (6) *pengrawit*, (7) *kepuhan apitan*, (8) *semar tinandhu*, (9) *lambangsari*, (10) *wantah apitan*, (11) *hageng*, and (12) *mangkurat* (Ismunandar, 1990).

Table 6: Types of Joglo Traditional Buildings.
Source: Ismunandar.

No.	Joglo type	Description
1.	*Jompongan*	▪ Joglo which has a 1:1 ratio of *belandar* (longitudinal beam) and *pengeret* (transverse beam) length, is the basic form of Joglo. ▪ It has 2 *pengeret* (transverse beams). ▪ It has 16 *saka* (columns). ▪ It has 2 sectors: *guru* sector and *penanggap* sector. ▪ It has 2 roofs: *brunjung* roof and *penanggap* roof.
2.	*Kepuhan Lawakan*	▪ Joglo without *geganja* (hanging beam stabilizers). ▪ It has 16 *saka* (columns). ▪ It has 2 sectors: *guru* sector and *penanggap* sector. ▪ It has 2 roofs: *brunjung* roof and *penanggap* roof.
3.	*Ceblokan*	▪ Joglo that uses *saka pendem* (columns without foundations). ▪ It has 16 saka (columns). ▪ It has 2 sectors: *guru* sector and *penanggap* sector. ▪ It has 2 roofs: *brunjung* roof and *penanggap* roof.
4.	*Kepuhan Limolasan*	▪ Identical to Joglo *kepuhan lawakan.* ▪ Using a long *sunduk bandhang* (longitudinal beams) and short *ander.* (hanging beams). Using double *uleng* (inner ceiling). ▪ It has 16 *saka* (columns). ▪ It has 2 sectors: *guru* sector and *penanggap* sector. ▪ It has 2 roofs: *brunjung* roof and *penanggap* roof.
5.	*Sinom Apitan*	▪ Using 3 *pengeret* (transverse beams) and *tumpangsari* (ceiling beam arrangement). ▪ It has 36 *saka* (columns). ▪ It has 3 sectors: *guru* sector, *penanggap* sector and *emper* sector. ▪ It has 3 roofs: *brunjung* roof, *penanggap* roof and *emper* roof.
6.	*Pengrawit*	▪ Using *lambang gantung* (the edges of the roof stretch). *Brunjung* roof is stretched from the *penanggap* roof. *Penanggap* roof is stretched from the *emper* roof. ▪ Using *saka bentung* (hanging columns) embedded in *dudur* (hip beams), using *tumpangsar*i (ceiling beam arrangement), *geganja* (hanging beam stabilizers) and *singup* (ceiling). ▪ It has 44 *saka* (columns). ▪ It has 3 sectors: *guru* sector, *penanggap* sector and *emper* sector. ▪ It has 3 roofs: *brunjung* roof, *penanggap* roof and *emper* roof.
7.	*Kepuhan Apitan*	▪ Identical to Joglo *kepuhan limolasan.* ▪ Using a short *pengeret* (transverse beam). ▪ It has 16 *saka* (columns). ▪ It has 2 sectors: *guru* sector and *penanggap* sector. ▪ It has 2 roofs: *brunjung* roof and *penanggap* roof.
8.	*Semar Tinandhu*	▪ Using the saka *guru* located between the 2 *pengeret* (transverse beam), usually replaced by a wall. ▪ It has 8 *saka* (columns). ▪ It has 2 sectors: *guru* sector and *penanggap* sector. ▪ It has 2 roofs: *brunjung* roof and *penanggap* roof.
9.	*Lambangsari*	▪ Using *lambangsari* (lisplank), *tumpangsari* (ceiling beam arrangement), *godhegan* (elbow) and double *uleng* (inner ceiling). ▪ It has 16 *saka* (columns).. ▪ It has 2 sectors: *guru* sector and *penanggap* sector. ▪ It has 2 roofs: *brunjung* roof and *penanggap* roof.
10.	*Wantah Apitan*	▪ Using *tumpangsari* (ceiling beam arrangement), *singup* (ceiling) and *geganja* (hanging beam stabilizers). ▪ It has 16 *saka* (columns). ▪ It has 2 sectors: *guru* sector and *penanggap* sector. ▪ It has 2 roofs: *brunjung* roof and *penanggap* roof.
11.	*Hageng*	▪ Identical to Joglo *pengrawit* but has a larger size ▪ It has 76 *saka* (columns).

		▪ It has 4 sectors: *guru* sector, *penanggap* sector, *penitih* sector and *emper* sector. ▪ It has 4 roofs: *brunjung* roof, *penanggap* roof, *penitih* roof and *emper* roof.
12.	*Mangkurat*	▪ Identical to Joglo *pengrawit* but higher ▪ It has 44 *saka* (columns). ▪ It has 3 sectors: *guru* sector, *penanggap* sector and *emper* sector. ▪ It has 3 roofs: *brunjung* roof, *penanggap* roof and *emper* roof.

It must be understood that in the reconstruction of traditional Joglo buildings it is necessary to start from the first structural element to be worked on to the last element in a series of structural element configurations. The reconstruction process facilitates the implementation of construction. Reconstruction starts from the *guru* sector, and the lower structural elements *(umpak)* of the northeast zone. Usually, the Joglo buildings are oriented to the South.

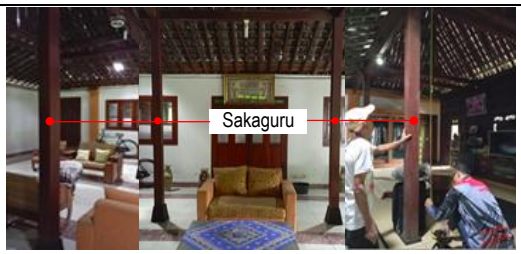
Table 7: Reconstruction Process of Joglo Traditional Buildings.
Source: Author.

Stage	Sector	Structure	Structural Elements
Stage 1	*Guru*	Lower Structure	*Umpak Saka Guru*
		Middle Structure	*Saka Guru, Belandar, Pengeret*
		Upper Structure	*Dudur, Dadapeksi, Ander, Molo*
Stage 2	*Penanggap*	Lower Structure	*Umpak Saka Rawa*
		Middle Structure	*Saka Rawa, Belandar Penanggap, Pengeret Penanggap*
		Upper Structure	*Dudur Penanggap*
Stage 3	*Penitih*	Lower Structure	*Umpak Saka Penitih*
		Middle Structure	*Saka Penitih, Belandar Penitih, Pengeret Penitih*
		Upper Structure	*Dudur Penitih*
Stage 4	*Emper*	Lower Structure	*Umpak Saka Emper*
		Middle Structure	*Saka Emper, Belandar Emper, Pengeret Emper*
		Upper Structure	*Dudur Emper*

Traditional Joglo building structures consist of three parts, namely the lower structure, middle structure and upper structure. Lower structure has structural elements of *umpak* (foundation). Middle structure has structural elements of *saka guru* (first column), *belandar* (longitudinal beam) and *pengeret* (transverse beam). Upper structure has structural elements of *dadapeksi* (center transverse beam), *ander* (hanging beam), *dudur* (hip beam) and *molo* (ridge beam). These structural elements each have a relationship with each other.

Fig 1: Structure System of a Joglo Traditional Building.
Source: Author.

Table 8: Structural Elements of Joglo Traditional Buildings.
Source: Author.

Lower Structure	
Middle Structure	 
Upper Structure	

Research location is Klaten Regency, Central Java Province, Indonesia It was selected based on the existence of Joglo traditional buildings.

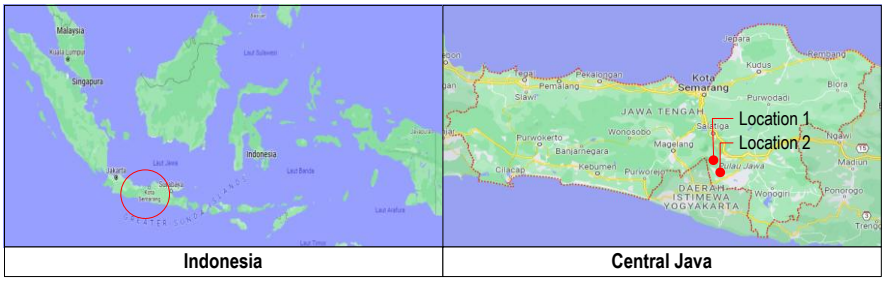


Fig 2: Research Location.
Source: Google Maps.

1. Girpasang
   Located in Tegalmulyo Village, Kemalang District, Klaten Regency, Central Java Province, Indonesia. There is a Joglo building that is under construction so that it can explore in detail the structural elements of the Joglo building.

2. Karanggeneng
Located in Ngawen District, Klaten Regency, Central Java Province, Indonesia. There is a 300-year-old Joglo building.

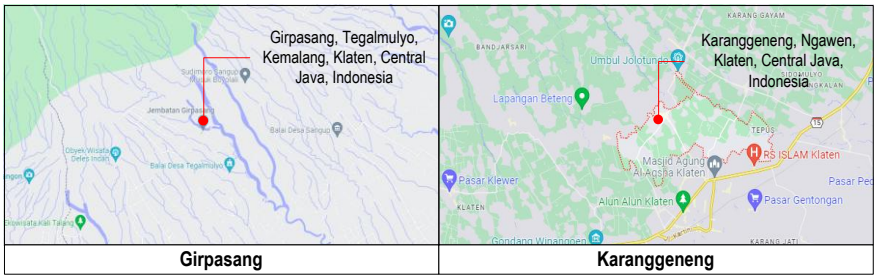


Fig 3: Research Location 1 and Research Location 2.
Source: Google Maps.

Conceptual Model of the Information System

If one looks in detail at the structure of the Joglo traditional building, one can mention the parts of the building, starting from the type, reconstruction, and the structural elements. Imagine if these parts are decomposed and then reassembled, of course, one will find difficulties in identifying and reassembling them as a whole. From components have structural elements. Each structural element has criteria, shape, material, dimensions, construction system and meaning.

In order to reassemble the structural elements of the traditional Joglo buildings, a guide is needed. There are three activities in the Joglo traditional building structure information system: input, process, and output activities. The input activity is the collection of raw data from observations, interviews and literature data into the information system. The data set includes the type, reconstruction and structural elements of the Joglo buildings. The process activity is to process and manage the input data obtained into a form that has meaning or a format that can be understood as information. The output activity is the distribution of information to information users.

This prototype information system can be accessed by application-based users, which can be applied to the Indonesian Traditional Values and History Preservation Center as well as the person in charge of managing the system. Meanwhile, information users are people who still apply the concept of Joglo traditional architecture, construction service providers, Joglo building construction experts. The information system to reconstruct of traditional building structures can be part of the Indonesian traditional architecture information system. This information system is still limited to the knowledge of Joglo building structures in terms of types, reconstruction processes, and structural elements of Joglo buildings.

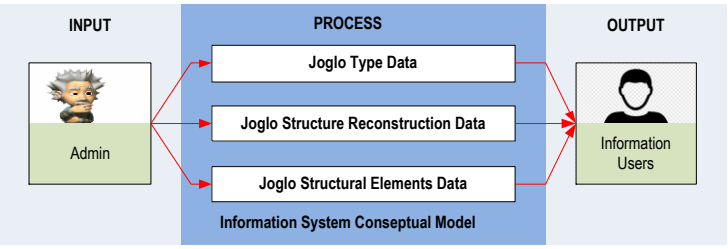


Fig 4: Conceptual Model Diagram of Joglo Traditional Building Information System.
Source: Author.

Information System Design

To define the characteristics of each component of the joglo traditional building structure, the database structure requires knowledge acquisition, knowledge representation and

knowledge representation tree for the system to work. Acquisition is the accumulation, transfer and transformation of knowledge. Based on the observations that have been made, knowledge acquisition about the composition of the attributes of the traditional joglo building structure is divided into types: structural reconstruction processes and structural elements of traditional Joglo buildings.

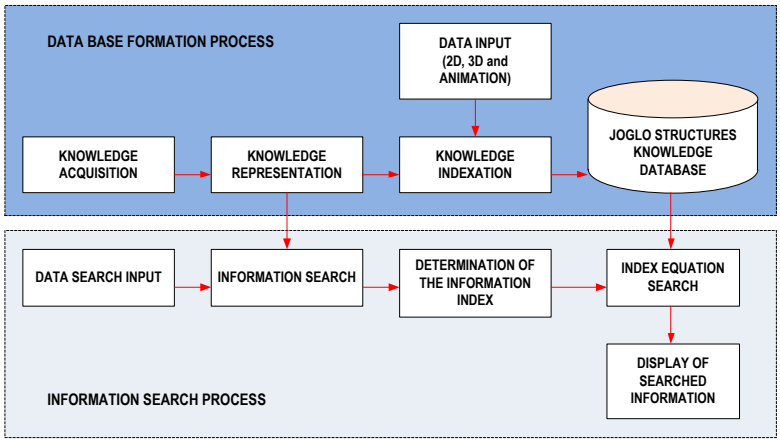


Fig 5: Schematic Design of Joglo Traditional Building Structure Reconstruction Information System. Source: Author.

Knowledge Acquisition

Knowledge acquisition is the process of acquiring knowledge to build a data base. Knowledge is collected as information for information system users. In this stage, knowledge is accumulated, transferred and transformed into computer programmes.

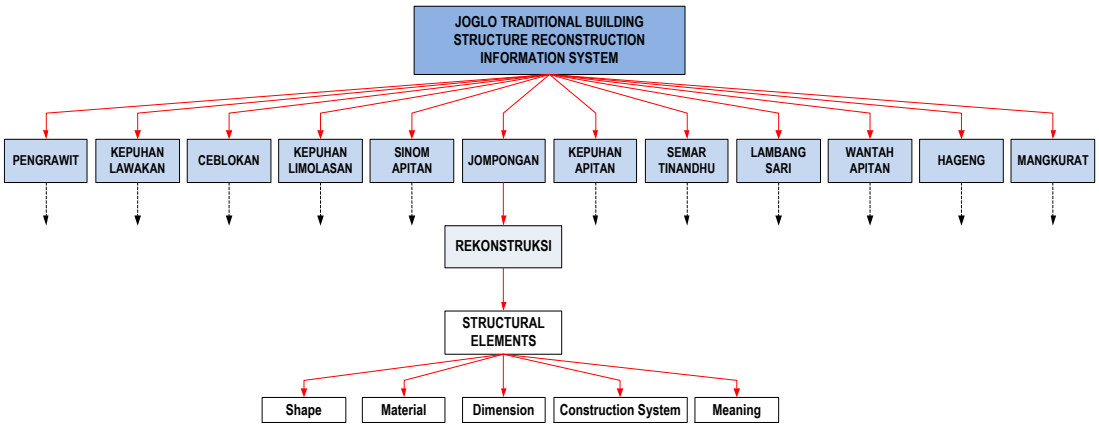


Fig. 6: Knowledge Acquisition of Joglo Traditional Building Structure Reconstruction. Source: Author.

Knowledge Representation

Grouping knowledge components so that they can be expressed by the programme requires a representation of knowledge that is easy to understand, so that the relationship between knowledge components can be known. Representation is the meaning of concepts that exist in the mind using language. Representation is the process of producing meaning using language (Hall, 2003). The main frame of the knowledge base is the Joglo traditional building type.

Table 9: Types of Joglo Traditional Buildings.
Source: Author.

Joglo Type Master		**Joglo Type Master Transaction**
Type Code	Type Name	Output
J1	*Jompongan*	▪ Roof Arrangement ▪ Space Arrangement ▪ Specific Structural Elements
J2	*Kepuhan Lawakan*	
J3	*Ceblokan*	
J4	*Kepuhan Limolasan*	
J5	*Sinom Apitan*	
J6	*Pengrawit*	
J7	*Kepuhan Apitan*	
J8	*Semar Tinandhu*	
J9	*Lambangsari*	
J10	*Wantah Apitan*	
J11	*Hageng*	
J12	*Mangkurat*	

Description:
J(1 – 12): Joglo (Type)

Next, knowledge base is the structural reconstruction process, which describes the reconfiguration of the structural elements of the traditional joglo building.

Table 10: Reconstruction of Joglo Traditional Building Structure.
Source: Author.

Joglo Reconstruction Master		**Joglo Reconstruction Master Transaction**
Reconstruction Code	Reconstruction Name	Output
RSJ1	Joglo *Jompongan* Reconstruction	▪ Structural Reconstruction Process of Joglo Traditional building
RSJ2	Joglo *Kepuhan Lawakan* Reconstruction	
RSJ3	Joglo *Ceblokan* Reconstruction	
RSJ4	Joglo *Kepuhan Limolasan* Reconstruction	
RSJ5	Joglo *Sinom Apitan* Reconstruction	
RSJ6	Joglo *Pengrawit* Reconstruction	
RSJ7	Joglo *Kepuhan Apitan* Reconstruction	
RSJ8	Joglo *Semar Tinandhu* Reconstruction	
RSJ9	Joglo *Lambangsari* Reconstruction	
RSJ10	Joglo *Wantah Apitan* Reconstruction	
RSJ11	Joglo *Hageng* Reconstruction	
RSJ12	Joglo *Mangkurat* Reconstruction	

Description:
RSJ (1 - 12): Joglo Structure Reconstruction (Type)

Structural elements present in the traditional Joglo building type are described for each section. An example is the knowledge representation for the basic Joglo form, and Joglo jompongan.

Table 11: Structural elements of the Joglo Jompongan building.
Source: Author

Joglo Structural Elements Master		**Joglo Structural Elements Master Transaction**
Structural Elements Code	Structural Elements Name	Output
SB111	*Umpak Saka Guru 1*	▪ Shape ▪ Material ▪ Dimension
SB112	*Umpak Saka Guru 2*	
SB113	*Umpak Saka Guru 3*	

SB114	*Umpak Saka Guru 4*	▪ Construction System ▪ Meaning
ST111	*Saka Guru 1*	▪ Shape ▪ Material ▪ Dimension ▪ Construction System ▪ Meaning
ST112	*Saka Guru 2*	
ST113	*Saka Guru 3*	
ST114	*Saka Guru 4*	
ST115	*Belandar 1*	
ST116	*Belandar 2*	
ST117	*Pengeret 1*	
ST118	*Pengeret 2*	
SA111	*Dudur 1*	▪ Shape ▪ Material ▪ Dimension ▪ Construction System ▪ Meaning
SA112	*Dudur 2*	
SA113	*Dudur 3*	
SA114	*Dudur 4*	
SA115	*Dadapeksi*	
SA116	*Ander*	
SA117	*Molo*	
SB121	*Umpak Saka Rawa 1*	▪ Shape ▪ Material ▪ Dimension ▪ Construction System ▪ Meaning
SB122	*Umpak Saka Rawa 2*	
SB123	*Umpak Saka Rawa 3*	
SB124	*Umpak Saka Rawa 4*	
SB125	*Umpak Saka Rawa 5*	
SB126	*Umpak Saka Rawa 6*	
SB127	*Umpak Saka Rawa 7*	
SB128	*Umpak Saka Rawa 8*	
SB129	*Umpak Saka Rawa 9*	
SB1210	*Umpak Saka Rawa 10*	
SB1211	*Umpak Saka Rawa 11*	
SB1212	*Umpak Saka Rawa 12*	
ST121	*Saka Rawa 1*	▪ Shape ▪ Material ▪ Dimension ▪ Construction System ▪ Meaning
ST122	*Saka Rawa 2*	
ST123	*Saka Rawa 3*	
ST124	*Saka Rawa 4*	
ST125	*Saka Rawa 5*	
ST126	*Saka Rawa 6*	
ST127	*Saka Rawa 7*	
ST128	*Saka Rawa 8*	
ST129	*Saka Rawa 9*	
ST1210	*Saka Rawa 10*	
ST1211	*Saka Rawa 11*	
ST1212	*Saka Rawa 12*	
ST1213	*Belandar penanggap 1*	
ST1214	*Belandar penanggap 2*	
ST1215	*Belandar penanggap 3*	
ST1216	*Belandar penanggap 4*	
ST1217	*Belandar penanggap 5*	
ST1218	*Belandar penanggap 6*	
ST1219	*Belandar penanggap 7*	
ST1220	*Belandar penanggap 8*	
ST1221	*Belandar penanggap 9*	
ST1222	*Belandar penanggap 10*	
ST1223	*Pengeret penanggap 1*	
ST1224	*Pengeret penanggap 2*	
ST1225	*Pengeret penanggap 3*	
ST1226	*Pengeret penanggap 4*	
ST1227	*Pengeret penanggap 5*	
ST1228	*Pengeret penanggap 6*	

ST1229	*Pengeret penanggap 7*	
ST1230	*Pengeret penanggap 8*	
ST1231	*Pengeret penanggap 9*	
ST1232	*Pengeret penanggap 10*	
SA121	*Dudur penanggap 1*	▪ Shape ▪ Material ▪ Dimension ▪ Construction System ▪ Meaning
SA122	*Dudur penanggap 2*	
SA123	*Dudur penanggap 3*	
SA124	*Dudur penanggap 4*	

Description:
SB (1 – 12) (1 – 4) (1 – ~): Lower Structure (Type) (Sector) (Structural Elements).
ST (1 – 12) (1 – 4) (1 – ~): Middle Structure (Type) (Sector) (Structural Elements).
SA (1 – 12) (1 – 4) (1 – ~): Upper Structure (Type) (Sector) (Structural Elements).

Knowledge representation is a method used to encode knowledge in an information system, intended to capture important properties of structural components and make that information accessible to inference machines/knowledge engineers. To facilitate the representation of knowledge of the attributes of the Joglo traditional building structure, it is necessary to perform attribute indexation and coding.

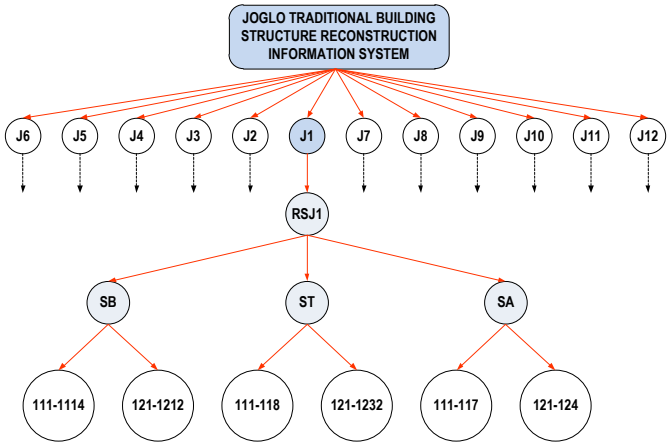


Fig 7: Representation of Joglo Traditional Building Structure Reconstruction.
Source: Author.

Information System Development

Information system development requires three process requirements which can be seen in the use case diagram. Use case diagrams describe the interaction relationship between the system and the actors. Use cases can describe the type of interaction between the user and the system.

Data flow is the flow of data from the input process to output. Data store contains data related to the Joglo types, reconstruction processes and structural elements of traditional Joglo buildings. Data store can only be managed by the admin. It uses the concept of convergent data flow, which is a convergent data flow that shows more than one data flow originating from different sources merging into one towards the same destination.

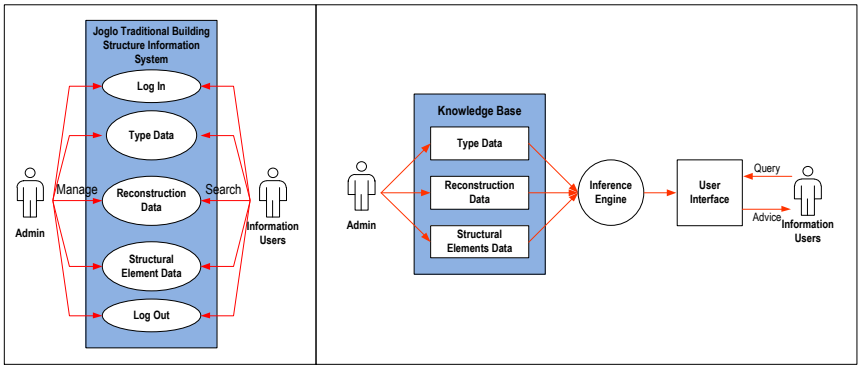


Fig 8: Use Case Diagram and Data Flow Diagram of Joglo Traditional Building Structure Reconstruction Information System.

Information System Search Method

Best First Search method is a method that is applied to the Joglo Traditional Building Reconstruction Information System. Information search is needed to find the desired knowledge information for the information seekers.

- Level 1 search: Joglo type, selected is Jompongan at node J1.
- Level 2 search: Joglo reconstruction.
- Level 3 search: structural elements, there is a choice of lower, middle and upper structural elements.

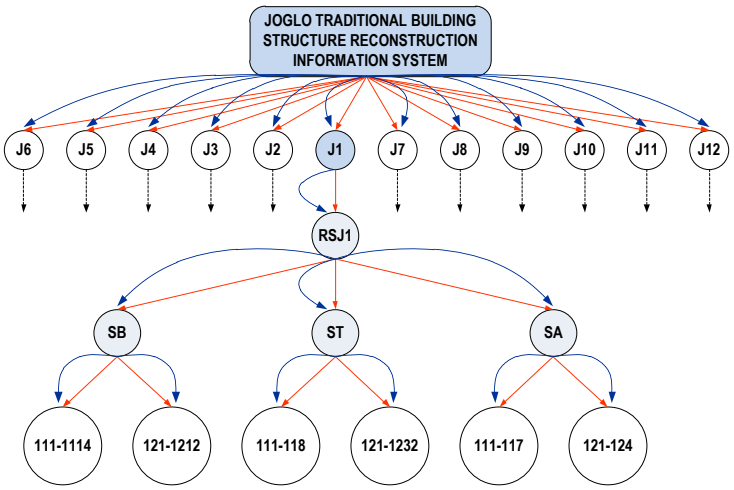


Fig 9: Best First Search method.

Results and Discussion

Display Design

Display design is divided into five parts, consisting of: splash screen, home, type page, reconstruction page and structural elements page of Joglo traditional building structure. Splashscreen displays the log in menu, Home page has several main menus including types, reconstruction and structural elements, Types page displays the types of the Joglo traditional buildings in the form of a list, The Reconstruction page describes the first structural element to be assembled up to the last element in a series of structural element configurations, Structural elements page contains the shape, material, dimension, construction system and meaning of the structural elements.

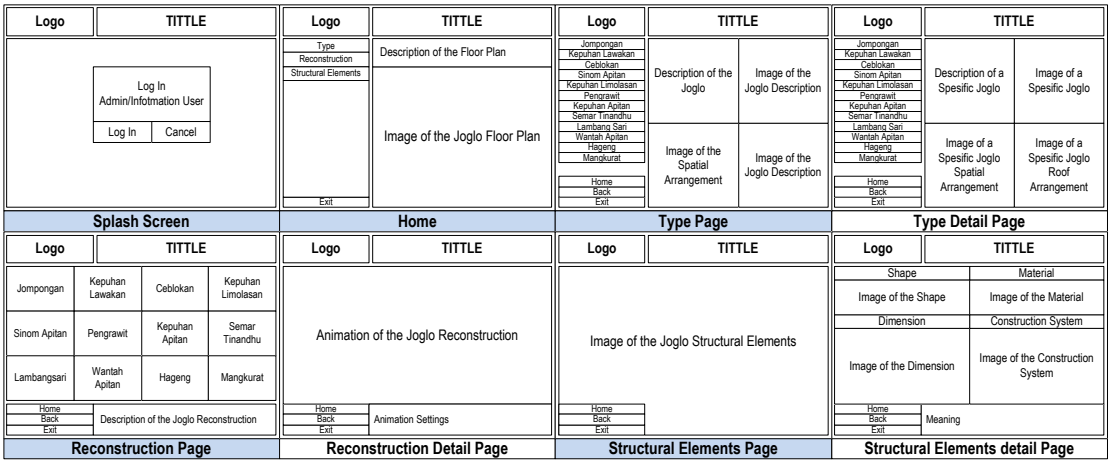


Fig 10: Display Design of Joglo Traditional Building Structure Reconstruction Information System. Source: Author

Information System Implementation

The implementation of this information system is a prototype provided for the users who seek knowledge of the reconstruction process of the traditional Joglo building structures. This prototype is a means of connecting the system with the users, has a function to enter, delete, replace and provide data output information about the type, reconstruction process and structural elements of traditional Joglo buildings.

In order to facilitate the users in browsing this information system, five main navigation structures are provided as a guide in operating the system.

Step 1: Spalsh screen Page
The first time the system operates, the opening page will appear. On the opening page there is a log in menu. There are two users/actors in this information system design, namely admin and visitors. Admins can access the information menu and Joglo structure information system database. While information users can only access the Joglo structure information menu.

Step 2: Home Page
Home is the main display when login is successful and can be accessed repeatedly. Home contains the main menu or the module, namely: types, reconstruction, structural elements of the traditional Joglo buildings.

Step 3: Type Page
Displays of 12 types of Joglo buildings contain a description of Joglo in general, a picture of the roof arrangement, a picture of the room arrangement and a picture of Joglo in general.

Step 4: Reconstruction Page
Displays the process of reconstructing a Joglo traditional building structure by selecting one of the desired Joglo types.

Sep 5: Structural Elements Page
Display of the structural elements contained in one of the desired Joglo traditional building types along with the details of the structural elements containing the shape, material, dimension, connection system and meaning contained in the structural elements.

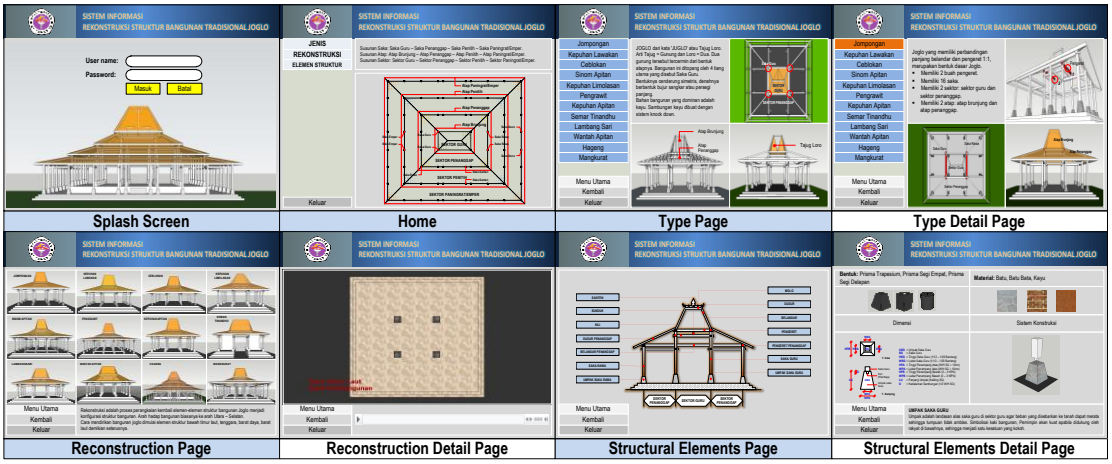


Fig 11: Display Splash screen, Home, Joglo Type, Reconstruction and Structural Elements of Information Systems.
Source: Author

Testing

Testing of the information system that has been built aims to see the extent to which the features that have been made and the system can run well in accordance with the design and achieve the expected goals. Testing is carried out by the admins, information users, visitors and the system operations.

Conclusions

Information system applications for reconstruction of the structure of traditional Joglo buildings are currently still implemented on the desktop. How to operate by pressing the application shortcut button on the desktop screen.

1. Splash screen is the opening page of the information system. On this page, users can log in by entering a user name and password validated by the system.
2. After successful login, the system will display the home page. On this page there are 3 menu options: types, reconstructions and structural elements of the Joglo building. Users can choose a menu according to what they want to find.
3. When user selects the type menu, the type page is displayed. On this page, there is a menu of 12 types of Joglo as a list. The information user can select one of the desired types of Joglo and the system will display a supporting page, namely the Type Details page, by providing information in the form of details of the selected type of Joglo in terms of the use of certain structural elements, the arrangement of space and the roof arrangement of the Joglo building.
4. When the information user selects the reconstruction menu, the reconstruction page is displayed with a menu of Joglo type options that will be reconstructed in the form of images. The information user can select a type of Joglo that he wants to reconstruct, then the system will display a page that supports the reconstruction process by providing knowledge of the reconstruction process from the first structural elements in the building to the last element sequentially presented in animation format.
5. When the information user selects the structural element menu, the structural element page is displayed with a menu of structural element options found in the selected Joglo building. The display of the Joglo building is in the form of a sectional drawing. Information users can select one of the structural elements of the Joglo building, then the system will display a structural element detail page. On the structural element detail page there is knowledge about structural elements in terms of shape elements, materials used, dimensions, construction systems and meanings of these structural elements.

6. Each page has a help menu, namely home to return to the home page, back to return to the previous page, and exit to exit the system. Except for the home page, there are only back and exit help menus.

Recommendation

This prototype of Joglo Traditional Building Structure Reconstruction Information System has limitations; some things that need to be developed in the next discussion.

1. Javanese traditional architecture is very diverse; there are still other types: limasan, kampung, tajug and panggang-pe. With the addition of the types of Javanese architecture, there will be more knowledge that can be presented.
2. The development of the Joglo traditional building research review was expanded not limited to the building structure, but added others: function and aesthetic.

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