A CASE STUDY ON COMPARISON BETWEEN WOOD TRUSS AND STEEL TRUSS FOR ROOF STRUCTURE

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ABSTRACT

Roof is an important structure found in all types of buildings regardless of size and shape. The using of wood trusses is widely used for generations before. With the growing construction on this time, there are other alternatives to replace wood truss that is widely use before with steel roof truss. Both have advantages and disadvantages respectively. Features such as workability, durability or strength, and suitability of the building will determine the type of truss to be used. Therefore, this study was undertaken to determine the truss suitable for use at this time. This approach is through questionnaires, observations, and the costs associated with the use of the two trusses. From this study, we can conclude that both have advantages and disadvantages truss, because they both have a lot different in terms of workability and the durability or strength. The results of research shows that the advantages mostly on using the steel truss. This difference makes them both special and acting as principle and the contractor or developer choice to build such a building.

ABSTRAK

Bumbung adalah merupakan satu struktur penting yang terdapat dalam semua jenis bangunan tanpa mengira saiz dan bentuk. Penggunaan kekuda kayu adalah digunakan secara meluas oleh generasi sebelum ini. Dengan pembangunan yang semakin pesat membangun pada hari ini, terdapat alternatif lain untuk menggantikan kayu yang digunakan secara meluas sebelum ini dengan menggunakan kekuda keluli untuk struktur bumbung. Kedua-duanya mempunyai kelebihandan kekurangan masing-masing. Ciri-ciri seperti cara pemasangan, ketahanan atau kekuatan, dan kesesuaian bangunan itu akan menentukan jenis yang akan digunakan. Oleh itu, kajian ini dijalankan untuk menentukan kekuda yang sesuai untuk digunakan pada masa ini. Pendekatan ini adalah melalui soal selidik dan pemerhatian yang berkaitan dengan penggunaan kedua-dua kekuda. Daripada kajian ini, kita boleh membuat kesimpulan bahawa kedua-duanya mempunyai kebaikan dan keburukan kekuda, kerana kedua-duanya mempunyai banyak perbezaan dari segi ,ketahanan atau kekuatan dan kos. Hasil kajian menunjukkan bahawa kelebihan kebanyakannya adalah dengan menggunakan kekuda keluli terutamanya untuk kekuda bumbung. Perbezaan ini menjadikan mereka kedua-dua khas dan bertindak sebagai prinsipal dan pemilihan kontraktor atau pemaju untuk membina apa-apa bangunan.

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Malaysia is rapidly developing in line with the government's vision of working towards a developed nation by the year 2020, and government have implemented various types of development such as schools, government offices, hospitals, factories, housing, and so on. Accordingly, the use of roof trusses is one important foundation for every building, regardless of whether the roof trusses are constructed of wood or steel.

Wood is a material that has long been used in the construction of the structure. Interesting and rewarding design often produced from wood material. Apart from its use in building structures of various shapes, wood is also used as a temporary structure for structural concrete, brick and stone. Nowadays the wood is still an important material in the construction, although there have been a lot of new materials created and used for construction.

Wood also has many uses and advantages that are not may be available on other materials, and it is more easily done by just using common hand tools. High understanding of natural events, the advantages and disadvantages of wood is very important in building design of timber structures. Only higher level of maturity wood is suitable for the construction of the structure.

In general, this study was conducted to gather information on the use of roof trusses (steel trusses). Because at present, has many housing projects using steel roof truss structure replaces a wood truss structure is widely used before. Construction of steel roof trusses had long been introduced in the country. Mostly, it is used in buildings such as halls and warehouses, and also includes the housing project. The technology is still not popular among the developers may be due to the system is still new and our society still hesitate to use it. Another possibility is steel roof truss system is considered unsafe and may easily cause problems causing our society to consume less system.

Accordingly, a study involving the cooperation of government and private agencies such as the Department of Public Works and construction and contractor is intended to provide a procedure on the difference between building structures using steel trusses and wood trusses. Among the benefits derived from this study is to identify the use of roof trusses and timber trusses which in terms of advantages and disadvantages as well as the privilege of using the structure, and thus can be used as a more effective framework in terms of building on the present and gives the developer more alternatives in terms of construction costs, building facilities and truss structure durability.

1.2 Problem Statement

Roof is an important part in the construction of a building. No buildings constructed without a roof. Thus, the components used to make the structure of the roof trusses must be high quality and durable. As noted, the wood has a lot of problems such as problem of termite attack, flammable, endurance less than 5 years and many more. Previously, wood widely used as roof trusses in terms of durability it is easy to decline compared with the use of steel. In terms of installation, the use of wood trusses is very complicated and requires high expertise compared with steel trusses easier and save time.

1.3 Objective of Study

i. Comparing the method of the installation of steel trusses and wood trusses.
ii. Determine the durability and strength of steel and wood.

1.4 Scope of Work

The buildings were selected for the study such as school buildings and bungalows using wood and steel as the material for the roof trusses.

a) Do research on the advantages, privileges and the use of wood and steel trusses. Analysis of the connection system is based on the size and type current applied.

b) Visit the site and meet with the parties involved to obtain more detailed information.

c) Collect data and display information from various aspects.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Wood is a material that has long been used in the construction of the structure. Interesting and satisfied design usually produced from wood material. In addition to build the structure of uses in variety of shapes, wood is also used as materials for temporary structures for structural concrete, brick and stone. Today wood remains as an important ingredient in the construction although there were many new materials are created and used for construction. This may be because the wood suitable as thermal insulation and estimated 15 times more heat-resistant than concrete including the suitability for the building that is always exposed to chemical gases (Mahyuddin Ramli, 1992). Wood is useful material that cannot be replace with other material because it is easily handle by using common hand tools. Understanding and knowledge of weakness of wood in the design of timber wood structure is important.

There are many type of wood available in Malaysia. Generally wood is divided into two:

i. Hard wood
ii. Soft wood

Majorities' in Malaysia hard wood available because hard wood are mostly found in tropical region like our country.

2.2 Wood Classification.

2.2.1 Types of Wood.

Forestry Department of Malaysia classified hardwood into three sub-groups based on the density and durability of natural wood. Based on the classification of wood Malaysian Grading Rules, (1984) classified the Malaysian timber as below:

i. Hardwood Weight (group A) has a density of 800kg/m^3 to 1200kg/m^3 at 15% moisture content (Tan Boon Tong, 1994). This type of strong wood and do not require any preservation treatment to be used. The type of wood are Balau Merah, Cengal, Giam, Belian, Merbau, Tembusu, Resak, Keranji, and Bitis.

ii. Medium Hardwood (group B) has a density of 720kg/m^3 to 880kg/m^3 at 15% moisture content (Tan Boon Tong, 1994). This type of natural wood less durability when exposed to weather and soil. Therefore this kind of wood requires preservation treatment. This is the type of timber Kempas, Kapur, Kasai, Kelat, Keruing, Kulim, Merawan, Petaling, Simpoh, Tualang, Mengkuas, Rengas, Resak, Tembusu and Jati.

iii. Light Hardwood (group C) has a density of 400kg/m^3 to 720kg/m^3 at 15% moisture content (Tan Boon Tong, 1994). This type of wood do not have natural durability. This is the type of wood Medang, Mersawa, Nyatoh, Petai, Pulai, Ramin, rubber wood, Sentang, sesendok, bintangor, durian and kedondong.

iv. Soft wood (group D) has a density less than 400kg/m^3. Wood in this category are dammar minyak, jelutung, Pulai, sempilor and podo.

Otherwise, wood also classified based on the strength of the wood. This new classification of wood classify into groups A, B, C and D, from wood that has a high strength to low strength depend on the basis and stress grade wood species. The strength of timber in Malaysia is divided into the following groups:

i. Group A: Balau, bitis, cengal, Giam, Keranji, Kempas and tualang with strength of 4.9 N/mm^2 to 9979 N/mm^2 (Tan Boon Tong, 1994).

ii. Group B: merbau, balau merah, Resak, Tembusu, kapur, kelat, keruing, Merawan, rengas and simpoh with strength from 4:34 N/mm^2 to 8.0 N/mm^2 (Tan Boon Tong, 1994).

iii. Group C: for example durian, kasai, medang, dark red meranti, light red meranti, mersawa, nyatoh, ramin, rubber and sentang with strength of 2.65 N/mm^2 to 6.0 N/mm^2 (Tan Boon Tong, 1994).

iv. Group D: damar minyak, jelutong, petai, Pulai and sesenduk. With strength of less than 2.0 N/mm^2.

2.2.2 Main properties of wood

For the purpose of structure and design, the main properties of wood used as a reference are:

i. Strength
ii. Moisture content
iii. Finishing.

2.2.3 Safety factor

Strength of wood depends on the factors of density, moisture content, wood grain structure, defects found in timber and wood modulus of elasticity. Typically wood has a high strength stronger than the wood has low strength. Although of the same type, there are also differences in terms of the strength of the wood. Strength variability is caused by growth factors, age, breed and resources.

Moisture content is the quantity of water content in the wood. Decline in wood moisture content will cause wood to shrink and may reduce the durability of the wood, so perfect drying should be done to prevent the wood from deformed or damaged. Wood used for interior work, it shall be 8% moisture content, while for external work, it must have a 15% moisture content. Below fiber saturation point, wood strength increased with decreasing moisture content of wood, while the fiber saturation point was no change in the strength of the wood.

Wood that had cut usually are not free from defects, this defect may occur from the growth process, splitting and drying. These defects destroy the look of wood finishes. Excessive drying, exposure to wind and rain, restructuring and imperfect wood distance will cause defect and influence of the wood finishing. Figure 2.1 shows the condition of the wood finish may occur.

There are several factors that should be considered in the design to determine the safety factor. These factors include the load, size, shape and other factors beyond engineering research.

2.3 Wood as material for roof truss structure

The roof is a structure built to protect steep or flat buildings constructed of wood, steel or concrete. It also acts as a self burden, the burden of roof coverings and wind load (Jahiman Badrom, 1988). Roof should meet the following requirements and characteristics

i. Stability
ii. Strength
iii. Durability
iv. Weather resistance
v. Resistance to fire
vi. Thermal insulation properties
vii. design of the building

Truss can be defined as a structural framework composed of members connected to each other. In principle, it is charged at the points of connection and internal stresses to its members. This is dependent on the tension compression (Jahiman Badrom, 1988). The wood used for the trusses should be the least of the group B. There are three basic types of trusses:

i. Arch truss (Figure 2.2)
ii. Steep truss (Figure 2.3)
iii. Flat truss (Figure 2.4)

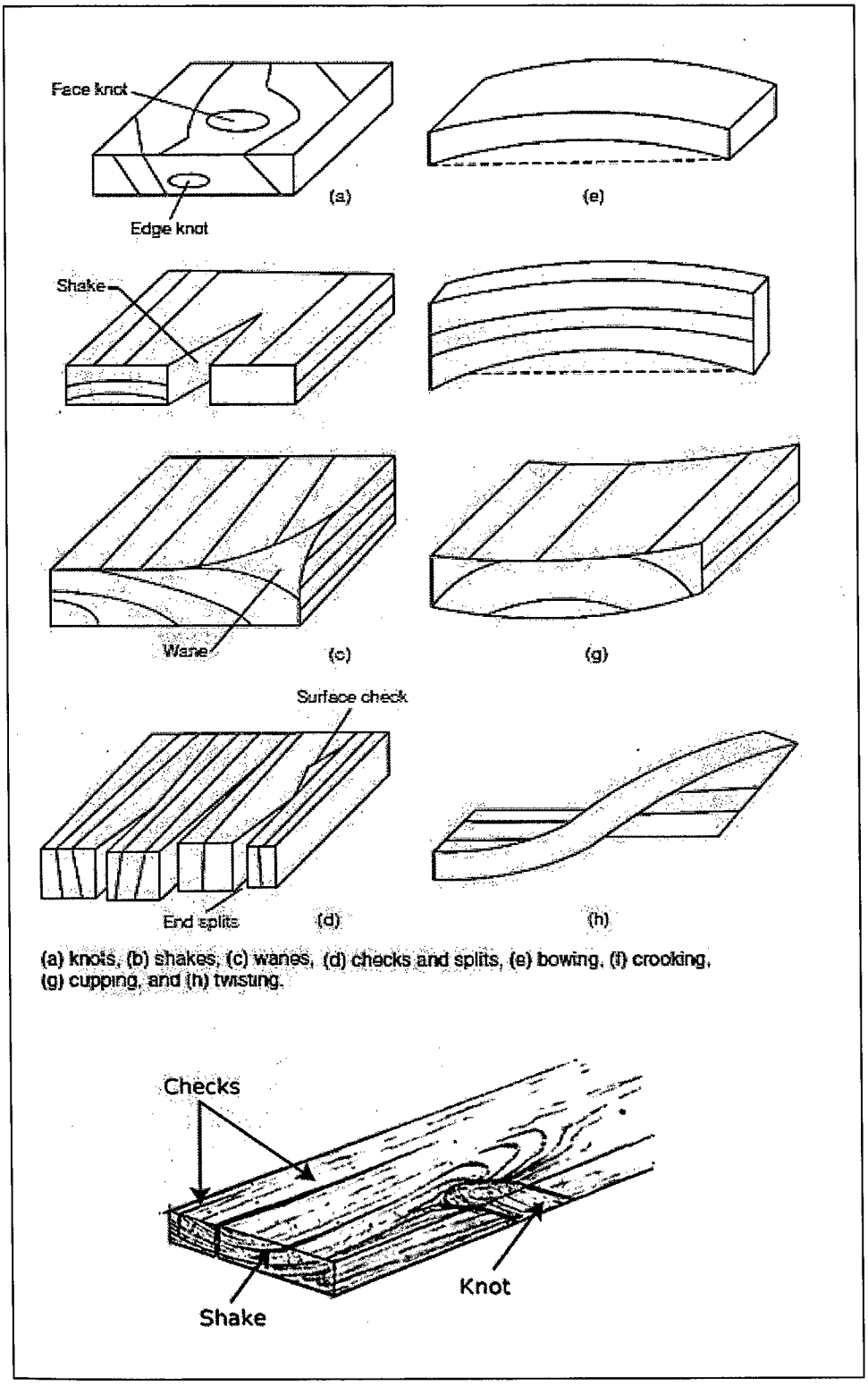

Figure 2.1 : Timber finish with defect.

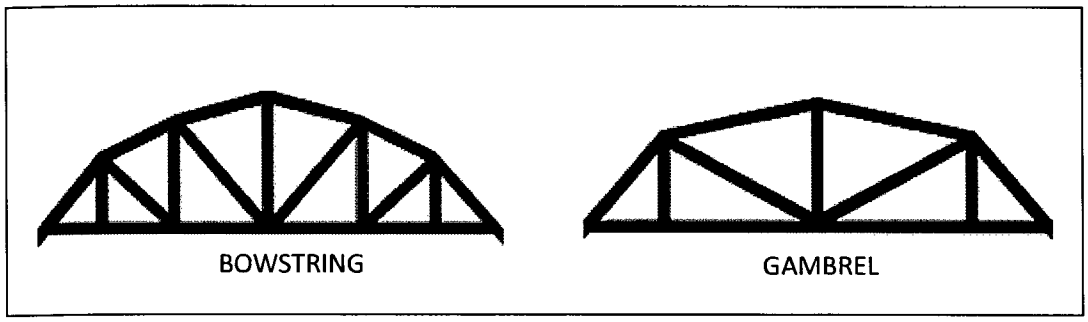

Figure 2.2: Arch Truss

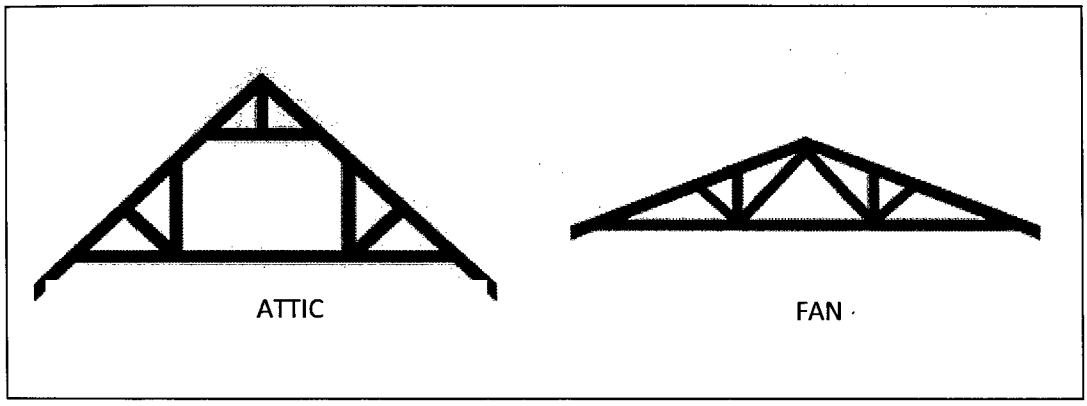

Figure 2.3: Steep Truss

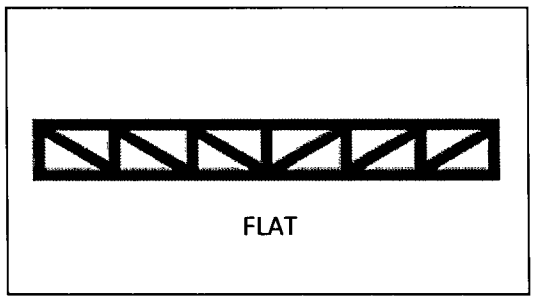

Figure 2.4: Flat Truss

The procedure to design the truss as shown below:

i. Select the layout and types of trusses appropriate.
ii. Allocates load on the roof.
iii. Analysis truss to obtain the forces in the members
iv. Moment analysis on the rafter and the bottom hanger ceilings.
v. Member design.
vi. Design connection
vii. Prepare detailed drawings.

2.3.1 Truss connection.

Appropriate connection need for the load of a structure to transfer a member to another member to be distributed safely and effectively. There are various types of connections in the market now among them are toothed plate (Figure 2.5), gusset plate (Figure 2.6), nail (Table 2.1,and Figure 2.7), bolts (Figure 2.8) , screws (figure 2.9), shear plates, and other patented connection type.

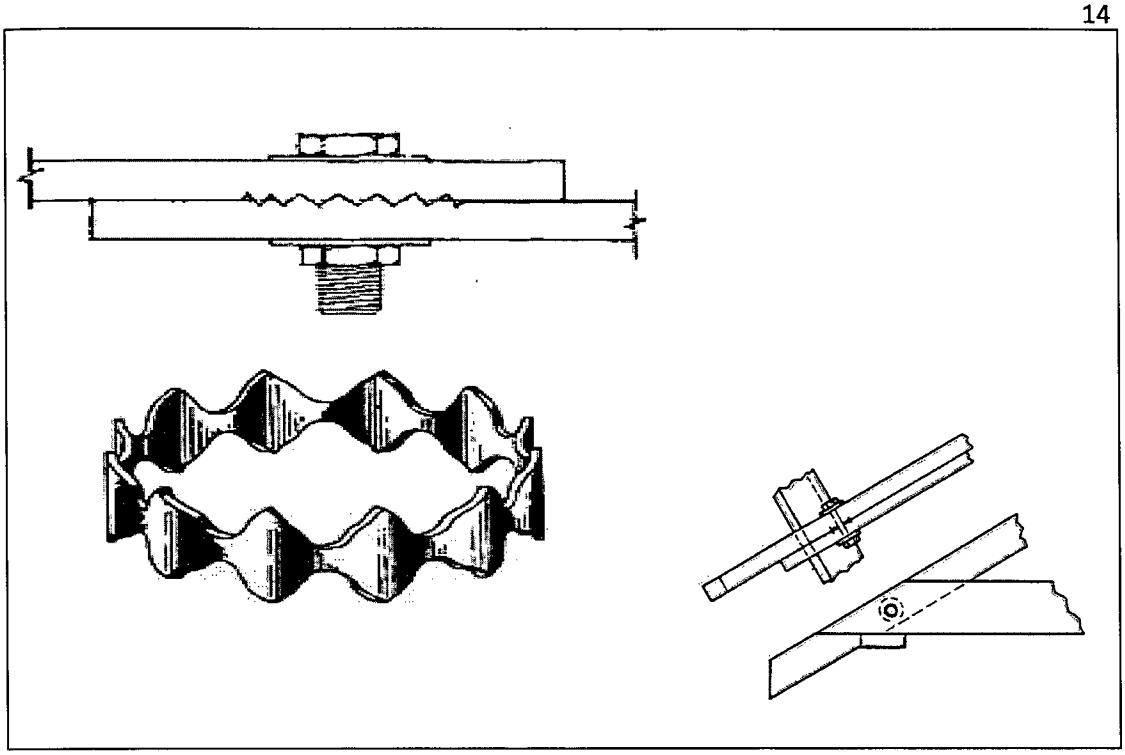

Figure 2.5: Toothed Plate

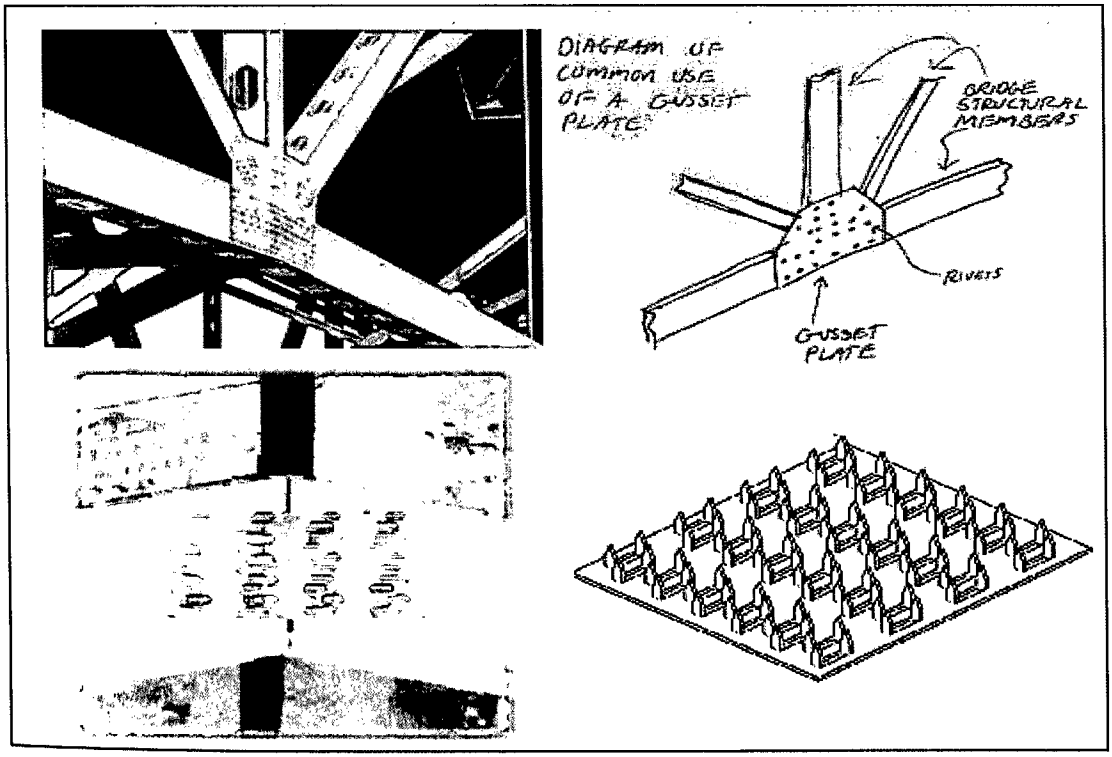

Figure 2.6: Gusset Plate