SIMPLIFIED DESIGN OF STRUCTURAL TIMBER

An Instructional Manual

Presented to

the Faculty of the Graduate School

CENTRAL PHILIPPINE UNIVERSITY

In Partial Fulfillment

of the Requirements for the Degree

MASTER IN ENGINEERING

Major in Engineering Education with

specialization in Civil Engineering

by

REGNIER A. REBALDO

May 1995

CHAPTER 1

TIMBER

1.1 INTRODUCTION. Timber is a material of construction most commonly used, and one of the most important of which buildings and other structures are built. It is found in many regions of the world. Compared with steel and reinforced concrete, timber is lighter, hence it is easy to transport. Timber may be classified as hard, tough, and flexible.

Wood has been used by man since time immemorial. It was probably the only material of which Noah's Ark was built that survived the universal Deluge. It has been used to built the humblest home as as well as the most beautiful and lavish palaces of monarchs, sovereigns, and potentates. It is a very useful material of construction in time of peace and in time of war.

1.2 TIMBER, WOOD, LUMBER. From Webster's dictionary are gathered the meanings of the following:

a. TIMBER is wood, whether on the tree or cut and seasoned, suitable for use in building, carpentry, etc.

b. WOOD is the hard fibrous substance of trees and shrubs beneath the bark.

c. LUMBER (cheifly U.S.A. and Canada) is timber, especially sawed or sliced into boards, etc.

d. LUMBERING (U.S.A. and Canada) is the business of getting timber or logs from the forest for lumber.

e. LOG is bulky length of a tree trunk or of unshaped timber.

f. LOGGING is the business of felling trees, cutting them into logs, and transporting the logs to sawmills or to market.

1.3. CHARACTERISTICS. Timbers are of many kinds, varrying greatly in their structural characteristics. Certain kinds of wood are more desirable for some purposes than others.

Green timber is heavier than dry or seasoned timber. Seasoned timber is that timber which has been subjected to controlled drying, thereby improving its strength. Green timber has a tendency to warp and to shrink. Moist timber is more flexible than dry timber.

Dry timber is lighter than green timber, has greater strength, and works better than green timber in sizing, sawing, and in making tight joints and connections.

Soft wood is brittle, while most hardwood is flexible. Hardwoods do not split as easily as soft,woods.

Any kind of timber shrinks as it dries, and for this reason, shrinkage should be taken into account in the construction of big buildings and bridges. Since shrinkage

in timber can cause a great damage or serious defects, it would be best to use seasoned timber whenever possible.

1.4. PRESERVATION OF WOOD. One of the disadvantages of wood as a structural material is that it is subject to decay. However, if used under proper conditions, the wood in a structure will generally outlive the useful life of the structure itself. Among the causes of decay are the following: (1) alternating wetness and dryness, resulting in wet rot, (2) lack of ventilation, resulting in dry rot, and (3) the destructive action of fungi, worms and insects. In most structures, the effects of these causes are readily controlled.

When it is known to the designer that the causes of decay cannot be eliminated, two solutions to the problem are available: (1) to allow the decaying process to proceed and to replace decayed timbers when necessary, in which case an average life of about six to ten years can be expected, or (2) to use timber treated with creosote or some other suitable preservative, in which case the average life is ten to fourteen years more, depending upon the degree of exposure to decay. In the creosote treatment, the timber, after having been properly seasoned, is placed in a closed cylindrical chamber, and steam is introduced to soften the wood fibres. Air and moisture in the timber are then removed by a vacuum pump finally, creosote is injected into the cylinder under pressure, resulting in almost complete penetration of the

wood fibres by the creosote preservative. Other simpler and less expensive preservative treatments are also being used.

1.5. CLASSIFICATION OF LUMBER:

1.5.1 YARD LUMBER is defined as lumber of all sizes and patterns intended for general building purposes. The grading of yard lumber is based on the intended use of the particular grade and is applied to each piece with reference to its size and length when graded without consideration to further manufacture.

(1) Strips. Yard lumber less than 50 mm thick and less than 200 mm wide.

(2) Boards. Yard lumber less than 50 mm thick, 200 mm or more wide.

(3) Dimension. All Yard lumber except boards, strips and timbers; that is yard lumber from 50 mm to but not including 125 mm thick, and of any width.

(4) Timbers. Lumber 125 mm or more in least dimension.

1.5.2 FACTORY AND SHOP LUMBER comprise of factory plank graded for door, sash and other cuttings 25 mm to 100 mm thick and 125 mm wide and over, intended for general millwork and other industrial commodities.

1.5.3 STRUCTURAL LUMBER is lumber intended for use where working stresses are required. Structural lumber may be classified into:

(1) Beams and Stringers. Lumber of rectangular cross-section,

125 mm or more thick and 100 mm or more wide, graded with respect to its strength in bending when loaded on the narrow face.

(2) Joist and Plank. Lumber of rectangular cross-section, 50 mm to, but not including 125 mm thick, and 100 mm or more wide, graded with respect to its strength in bending when loaded on the narrow face as a joist or on the wide face as a plank.

(3) Posts and Timbers. Lumber of square or approximately square cross-section 125 mm x 125 mm and larger, graded primarily for use as posts and columns carrying longitudinal load, but adopted for miscellaneous uses in which stringer in bending is not especially important.

1.6. SIZES. When logs are sawed, lumbers come out usually into standard commercial sizes of length, width, and thickness. These afford the structural designers a guide in their works. Whenever possible, only the standard sizes and lengths which are available commercially should be used. Inquiry from local lumber dealers will disclose the sizes and lengths carried in stocks generally.

The standard lengths of lumber are multiples of 0.6 m running commonly from 1.8 to 7.2 m for boards joist, beams, etc. The standard cross-sectional dimensions are multiples of 50 mm. Thickness of 25 mm or less is being counted as 25 mm thick in estimating.

The commercial sizes of Philippine timber are given in

Table 1.0.

1.7. ALLOWABLE STRESSES. Tests have been carried on various kinds of Philippine woods in order to determine the maximum amount of stress each kind of wood can bear. A factor of safety for such kind of stress for each wood.

The working stresses for visually stress-graded unseasoned structural timber of Philippine wood are given in Table 1.1.

1.8. USES OF PHILIPPINE TIMBERS. On the quality of the timber depends its use in construction.

Listed here under are the different uses of common Philippine timbers:

a. For general constructions: Aranga, Ipil, Manggachapui, Molave, Supa, and Tindalo.
b. For house constructions: Akleng,Parang, Amugis, Apitong, Ipil, Tanguile, and Yakal.
c. For posts (above ground): Akle, Akleng-Parang, Amugis, Aranga, Makaasim, Manggachapui, Molave, and Narig.
d. For beams and joists: Amugis, Apitong, Aranga, Batete, Kalumpit, Makaasim, Manggachapui and Yakal.
e. For trusses: Amugis, Apitong, Aranga, Kalumpit, and Makaasim.
f. For sidings: Dao, Makaasim, and Tanguile (Rizal)
g. For sheathing (interior): Batete, Kalumpit, Narra, and Tanguile.

h. For flooring: Amugis, Apitong, Aranga, Balete, Dao, Guijo, Kalumpit, Makaasim, Molave, Supa, Tindalo, and Yakal.

i. For paneling: Akle, Dao, and Supa.

j. For window frames: Ipil, Manggachapui, Molave, Narra, Tanguile, and Tindalo.

k. For doors: Batete, Ipil, Manggachapui, Molave, Narra, Tanguile, and Tindalo.

l. For door panels: Amugis, Ipil, Narra, and Tanguile.

m. For interior work: Akle, Almon, Bagtikan, Mayapis, Supa and Tanguile.

n. For interior finish: Amamanit, Aranga, Batete, Lumbayao, Marango, Palosapis, Tindalo, and White Lauan.

o. For forms: Almon, Apitong, Tanguile, and Yakal.

p. For piles: Apitong (creosoted), Aranga, (salt water piling), Bakauan, and Makaasim.

q. For railroad ties: Apitong (treated), Aranga, Pili, Molave, and Yakal.

r. For bridge building: Aranga, Makaasim, and Yakal.

s. For ship building:

Almon (for boat planking),

Bagtikan (for ship and boat planking),

Guijo (for ship and boat planking),

Makaasim,

Malagui (for masts and spurs, levers, and capstan bars),

Manggachapui,

Mayapis (for ship planking),

Molave (especially for keels and ribs),

Narra (for interior trim of boats),

Palosapis,

White Lauan (for boat planking)

Yakal (for ship framing and decking).

1. 9 IMPERFECTIONS. The imperfections in the timber generally impair its strength.

Defects weaken the timber. These are classified as knots, checks, heartshakes, windshakes, and starshakes.

Decay renders the timber unserviceable. The known types of decay are: dry rot, wet rot, and common rot.

Insects destroy the timber. The most common varieties of destructive insects are: the powder rot, pole borer, termites, and marine borer.

1.10. SELECTION OF LUMBER. It is very important to select the kind and grade of wood to be used for any work. A grade of lumber which contains sound standard knots may be used in work where there is no stress involved. Such lumber can be used in sidings, casings, bookshelves, partitions, trims, closets, cabinets, etc.