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REPUBLIC OF CAMEROON

Technical report: Roof trusses*

Prepared for the Government of the Republic of Cameroon
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

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* This document has not been edited.

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1. SCOPE OF REPORT

This report is part of the outputs required of UNIDO project DP/CMR/87/005 under the sub section covered by the job description 11-04 "Consultant en construction de charpentes et autres constructions en bois". (Attached as Annex 'A')

The job description limits the scope of buildings to "small and medium span". In practice this has been interpreted as 5 to 12 metres. However the end use of the buildings themselves is practically unlimited. This may result in only one significant difference in construction, whether or not a ceiling is included in the roof structure. This may affect lower chord lateral bracing required to stabilise a roof against wind uplift.

This report draws heavily on two previous reports by the same expert, viz:

- "A Trussed Rafter System" DP/ID/SER.A/353 (23 March 1982, UNIDO, Vienna (English, French) (1)

- "Strength Grouping of Timber" UNIDO/IO/R.173 (5 September 1985, (English)) (2)

Reference to the second report is desirable in order to fully understand some of the concepts contained in this report, but is not essential since the most important results are included here. Reference to the first report is considered essential to users, since this report is an extension of the trussed rafter concept adapted to the architecture, building practice and timbers of Cameroon.

Frequent reference is also made to Australian standard A.S. 1720 - 1975 "SAA Timber Engineering Code" (Standards Association of Australia, 80 Arthur Street, North Sydney, NSW. Australia).

Users of this report are advised to obtain a copy of this code.

At the time of writing (April 1989 US$1:00 = FCFA 318

2. CAMEROON CONSTRUCTION MATERIALS AND METHODS

1. Walls

The vast majority of buildings in Cameroon have walls made of masonry or earth. Masonry consists of hollow concrete blocks of dimensions (in centimetres) 40 L x 20 H x 15 or 10 W with cell wall thicknesses of 2 to 4. These are generally plastered. It was observed that the standard of workmanship of laying these to level is not high, with resulting inaccuracies in level at the roof line. Even when a reinforced concrete band is poured on top of the wall, this is frequently not accurately levelled on its upper surface.

Lower down the cost scale are sun dried earth blocks, rammed in moulds, and wattle and daub. Again, these may or may not be plastered, though more generally not.

A small proportion of buildings are in timber construction. These are made with 8 cm x 8 cm sawn posts set in the ground and covered with 30 cm horizontal boarding in as-sawn condition. The gaps between the boards are covered with 4 cm x 1 cm battens and short vertical battens may also be fixed to give a decorative pattern. Workmanship and materials in such buildings are generally poor, e.g. unplaned and warped timber, no alignment or mitering of boards at corners, boards out of level.

2. Roofs

A wide range of roof forms was observed. Some regional variations exist on a small scale. The most common roof forms are single or double pitch roofs of very flat pitch, generally not more than about 10°. Fig. 1 shows both forms which account for perhaps 60% of roof forms. Both these types have a deep fascia of about 60 cm and overhang the wall by about 1 m.

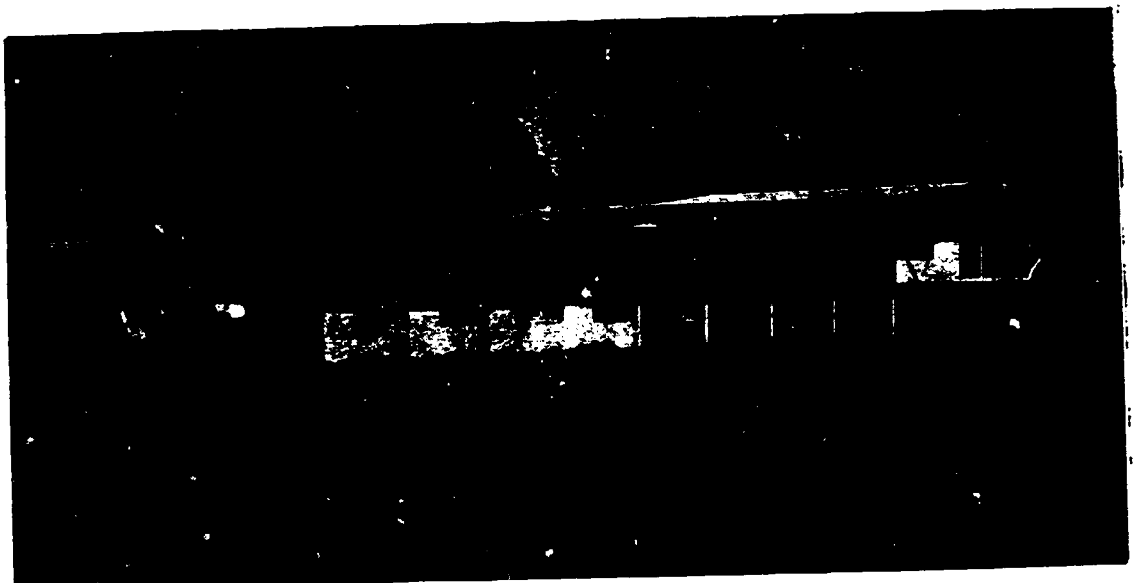


Fig 1. Partial view of the CUSS Annex health centre Bambili

Fig. 1 shows both forms in spans of about 6 m for the monopitch building in the foreground and 8 m for the gable building at the right rear. These are both very typical forms and dimensions.

Fairly common, perhaps amounting to 20% of total numbers are gable roofs with pitches 15° to 25° and fascia depth of 15 cm. Occasionally such roofs are hipped.

Local forms of traditional construction are multiple "steeple" roofs of pitches around $60^{\circ} - 65^{\circ}$ seen in the West and round buildings of diameters 5 to 8 m with roof pitches of 25° to 45°, mostly around 40°. These are most common in the North.

Most of the roof constructions are based on trusses spaced in the range of 1.5 m to 2 m. These trusses are site assembled and display numerous faults and weaknesses.

Faults which were observed included:

1. Trusses erected out of line, both vertically and horizontally.
2. Trusses supported in between panel points (nodes).
3. Inadequate splicing of top and bottom chord members.
4. Inadequate fixing at junctions, particularly at the heel points.
5. Inadequate lateral bracing, frequently complete absence of any lateral bracing.

Not all trusses displayed all the above faults although a few were seen which did, in which cases the results were horrifying. Too many jobs displayed one or two of these faults which spoiled an otherwise good job of work. However, there were some jobs seen which were excellent examples of the carpenter's art, showing that good levels of skill and knowledge do exist in Cameroon.

It was also interesting to observe that on the better quality jobs, the men were only too happy to have photographs taken, whereas on the poor quality jobs permission to take photographs was refused. This indicated that both pride in good workmanship and awareness of poor quality exist among tradesmen. These two sides of the same coin are encouraging for any technical innovation.

All the five faults listed above lead to an increased tendency for trusses to deflect excessively. Some, particularly faults in nos. 2 and 3, may lead to deflections approaching a state of collapse. Because of the generally small spans involved and the frequent occurrence of interior partition walls this will generally not be disastrous, but it can have very adverse effects on the appearance of roofs and ceilings which has been observed in several cases.

Faults 3 and 4 manifest themselves in a tendency for truss or triangulation action to be reduced and for beam action to be increased. It is very difficult to put absolute figures on this, but a qualitative indication may be given.

Consider a truss 1 m deep spanning 6 m, with top and bottom chords of 8 cm x 4 cm.

If perfect truss action obtains this could approach the stiffness of a plate girder with the two chords being the flanges of the girder. If zero truss action exists, then the chords will act as individual beams.

In the girder case, $I = 2\,Ar^2 = 2 \times 8 \times 4 \times 50^2 = 160\,000\ \text{cm}^4$

In the beam case, $I = \dfrac{2bd^3}{12} = \dfrac{2 \times 4 \times 8^3}{12} = 341{,}3\ \text{cm}^4$

Thus the extreme truss case is $\dfrac{16\,000}{341{,}3} = 469$ times

as stiff as the extreme beam case. In practice, a well made truss might be one third as stiff as the absolutely rigid (in shear terms) equivalent girder and even a small amount of truss action might increase the stiffness of the two beams by a factor of five. Even so a well made truss might be 20 to 50 times as stiff as one with highly deformed joints.

In a well made truss, experience shows a deflection of about $\frac{1}{1000}$ at mid span. In a 6 m span this is 6mm. In a badly made truss this could easily amount to 120 mm and sags of this order of magnitude have been observed on some buildings in Cameroon (fortunately on a very few).

3. Timber

Numerous species of timber were seen on sale. The species available vary slightly depending on the region, but commonly available are:

Central (Yaoundé)	
Bilinga	(Nauclea trillesii, N. diderichii)
Iroko	(Chlorofora exelsa)
Movingui	(Distemonanthus benthamianus)
Olon	(Fagara heitzii)
Ayous	(Triplochiton scleroxylon)
Frake	(Terminalia superba)
Eyong	(Sterculia oblonga)
Bibolo (Dibeton)	(Lovoa trichilioides)
Sapelli	(Entandophragma cylindricum)
Sipo	(Entandophragma utile)
Kossipo	(Entandophragma candollei)
Acajou	(Khaya ivorensis)
Ekop (Naga)	(Brachystegia cynometroides)
Ilomba	(Pycnanthus angolensis)
Moabi	(Baillonella toxisperma)
West (Bamenda)	
Eucalyptus	(Eucalyptus spp.)
Obeche	(Triplochiton scleroxylon)
Iroko	(Chlorofora exelsa)
Bibolo	(Lovoa trichilioides)
Sapelli	(Entandophragma cylindricum)
Movingui	(Distemonanthus benthamianus)
Mahogany	(Khsys ivorensis)

Extreme North (Maroua)

Obeche - in large quantities

Sapelli - in small quantities

The strength groups of these species vary widely and this subject is discussed elsewhere. Suffice it to say that all were more than adequate for construction purposes.

The presentation of the timber varied widely. By far the worst was seen at Bamenda. All timber on sale there had been milled by hand-held chain saw. The result was timber of extremely poor uniformity of dimension and cut anything but straight. The very poor dimensional quality of this timber would have a correspondingly bad effect on the carpentry done with it. It was no surprise that the lowest quality roof carpentry seen in Cameroon was in Bamenda, with this poor quality timber.

In the extreme north the timber seen on sale was excellently presented, uniformly dimensioned bandsawn Obeche in lengths of 4 and 6 metres. The dimensional quality of this timber was good by world standards.

Presentation in Yaoundé is intermediate with varying proportions of band, circular and chain sawn timber. The dimensional uniformity of the circular sawn timber is slightly lower than the band sawn timber.

The structural grade of all the timber seen was excellent, with well over 90% qualifying as 60% strength grade, and around 75% qualifying as 75% strength grade in terms of the Australian hardwood strength grading rules A.S. 2082. The most common defect is excessive slope of grain, then shakes, especially ring shakes and borer holes. Knots are rare.

If a suitable single source of timber were maintained, good quality trusses should be capable of being manufactured without having to plane to dimension.

4. Plywood

Good quality plywood is manufactured in Cameroon. The standard sheet size is 250cm x 122cm. Various thicknesses up to 19mm are available. None of the plywood on the local market is made with exterior type (phenolic) glue. It is therefore unsuitable for consideration as a structural material.

5. Roof Covering

Most forms of roof covering have been used in Cameroon. These include terra cotta tiles of various forms, bituminous felt shingles, thatch corrugated galvanised iron and corrugated and ribbed aluminium sheets.

At present the most commonly used materials are these last two. The sheet thickness is very thin being 0.5 or 0.6 mm in the better quality long sheets, but as thin as 0.3mm in the cheapest qualities. Even with the thicker sheets, more resistant to local deformation under the fixing nails, leaks are common at the fixing nail holes. This is exacerbated by the very flat roof pitches commonly employed.

6. Summary

Walls are mainly concrete or rammed earth. A small number of wooden walls are built in cheap low quality buildings.

Roofs: Many different types and shapes exist but the commonest recent construction features flat pitches often with deep fascias. Truss construction is widely used but is often ineffective for various reasons. Truss quality ranges from good to very poor.

Timber is available in a variety of species. Sawing quality ranges from excellent to extremely poor, as done with hand held chainsaws. This is general in the West. Timber grade is very high.

Plywood is readily available but only in interior quality and consequently is not suitable for structural purposes.

Roof covering is mostly aluminium sheets in thickness ranging from adequate to extremely thin.

7. Recommendations

1. Since most construction timber in Cameroon is used in roofs, CENADEFOR should concentrate its efforts in improving roof construction, introducing new methods where appropriate, also recommending minimum quality standards. Much of the latter part of this report could form a basis for these standards.

2. A major effort should be made to improve the quality of sawing in the West by constructing suitable sawmills. This is beyond the scope of this Project and will probably require international assistance. It is realised that such action may have political and social implications, such as the displacement of the present hand-sawyers and due regard must be taken of such matters.

3. Plywood could form a valuable structural material if available locally in exterior grade. The high quality of face veneers seen is not necessary for structural plywood either in grade or degree of finish.

4. Notwithstanding recommendation 1, an increase in timber construction could be achieved with wider use of timber wall construction. This requires a combination of workman education and availability of appropriate materials, e.g. planed profiled weatherboards. A well illustrated combined textbook: code reference manual (along the lines of the Fiji Pine Building Code) would be of great assistance. There is a very large amount of work in preparing such a document and again it is outside the scope of this section of the Project.

3. COMMERCIAL TIMBER

A commercial price list is included as Annexe B. Note that this is dated 10/3/84. Prices have risen since then and are now around F CFA 80.000 per m^3.

Table 1 shows concisely the commercial availability of the various common sizes, and in each square, linear metres per cubic metre, price per metre based on F CFA 80.000 per m^3 and the trade names by which the various dimensions are commonly known.

While the price list and Table 1, which was derived from it, show a wide variety of dimensions, small timber merchants normally only stock lattes, chevrons and planches of 3 cm x 30 cm in only 3 or 4 species.

Commercial timber is not graded for structural purposes, but as described elsewhere it is mostly of excellent grade apart from sawing irregularities and some warping.

Commercial timber should be graded in the factory according to the rules given in Annexe D. Apart from pieces with excessive slope of grain, a high recovery rate should result.

TABLE 1

DIMENSIONS & PRICES OF COMMERCIAL TIMBER

Thickness	WIDTHS 60	80	150	200	250	300	
30			222•2 360 planche →	166,6 480	133,3 600	111,1 720	m/m3 F CFA/m name
40		312,5 256 latte	166,6 480 planche →	125 640	100 800	83,3 960	
50			133,3 600 bastaing				
60	277,7 288 chevron		111,1 720	83,3 960	66,6 1200	55,5 1440	
80		156,25 [illegible] chevron	83,3 960 bastaing →	62,5 1280	50 1600	41;6 1923	

4. ROOF TRUSS DESIGN AND ANALYSIS

Roof truss design and analysis usually follows classical methods of the theory of statically determinate structures. This involves the adoption of numerous simplifying assumptions. Experience over years of design of millions of trusses shows that these assumptions give satisfactory, even conservative structures.

Graphical methods are most convenient for small design offices. Even CAD (Computer Aided Design) systems are largely electronic versions of graphical methods. A skilled design draughtsman should be able to design and detail a truss of moderate complexity in about 1½ hours.

Full explanations of graphic statics are found in standard textbooks of structural theory. What follows is a summary.

The design process should follow this sequence.

1. Draw the profile desired by the architect.

2. Decide how much of this can be trussed or triangulated by following a standard system for which cutting tables or coefficients are available.

3. Based on experience of truss spacing pitch and span, select approximate timber sizes.

4. Draw the complete truss (or half, if it is symmetrical) to scale.

5. Mark out forces and members by Bow's notation.

6. Calculate panel point loads and reactions, then analyse the forces in the various members by graphic statics.

7. From the member forces, determine the number of nails in each joint, then with the nailing pattern template, the plate sizes.

8. Check the rafter for combined bending and compression and all the web members for compression.

9. Complete the detail drawing of the truss and the joints.

Detailed comments on each of the above items is as follows:

1. If possible a standard pitch or profile should be adopted. This may involve discussions with the architect pointing out any disadvantages of his desired profile, arrangement etc.

2. It is much more efficient, from a manufacturing point of view if all truss components can be precalculated instead of a prototype having to be made. At the same time, good proportioning of panels should be maintained. At this stage also an awareness of the effects of member slopes is required. For example the forces at the heel of the W type trusses described in Ref. (1) increase with

$$\frac{1}{\sin\text{ (heel angle)}}.$$

For pitches under about $12\frac{1}{2}^{o}$ these forces become very large indeed. So where flat pitches are required, it is generally better to cantilever the truss, placing the heel at the eaves and thereby substantially increase the angle of the primary compression member.

A secondary advantage of doing this is that very flat pitches are frequently associated with wide overhangs. The cantilevered truss will give a much stronger and stiffer overhang than an extended top chord.

The differences resulting this change of truss type to a 6 m span, 1.5 m overhang, 10^{o} pitch roof are shown in Figs 2 and 3.

Fig. 2A shows the standard W truss and Fig 2B the corresponding force diagram. Fig. 3 show- a cantilevered truss under the same loading. Note the considerable reductions in member forces in Fig. 3 compared with Fig. 2, even though in Fig. 3 rather more load is being carried through truss action (in Fig. 2 the eaves load has no effect on forces within the truss proper).

3. Selection of timber sizes is done on a trial and error basis. With experience, the proportion of errors is reduced but not eliminated. Factors to be considered include availability of the particular species and grade, and of particular dimensions, or possibility of re-sawing to those dimensions specified with minimum waste. However, the smallest acceptable size may not necessarily be the cheapest. Resawing costs money and there is no point in resawing say 80 x 40 to 60 x 40 when no use can be made of the off-cut.

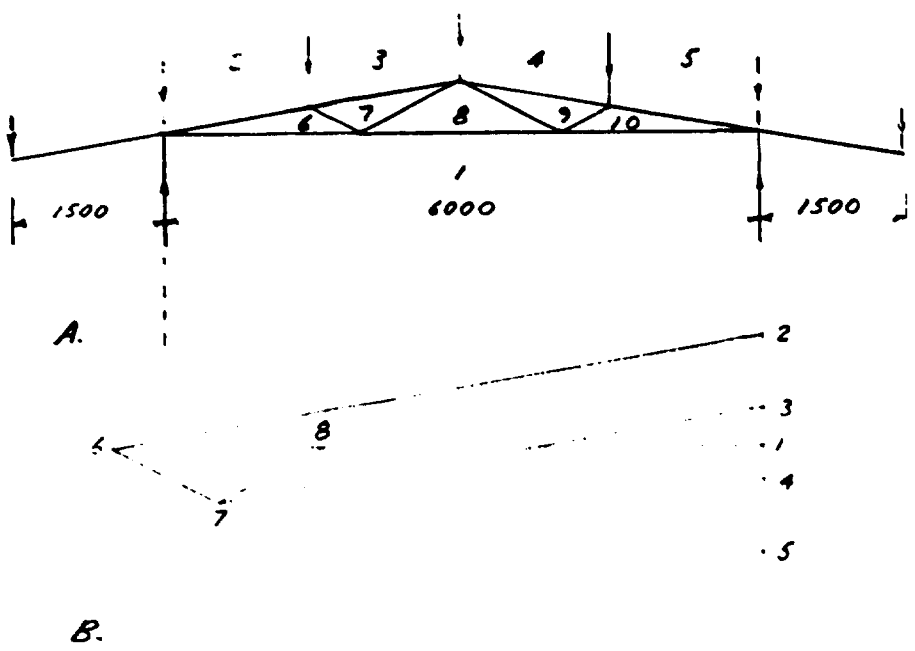


Fig 2. 6m SPAN • 10° PITCH 'W' TRUSS.

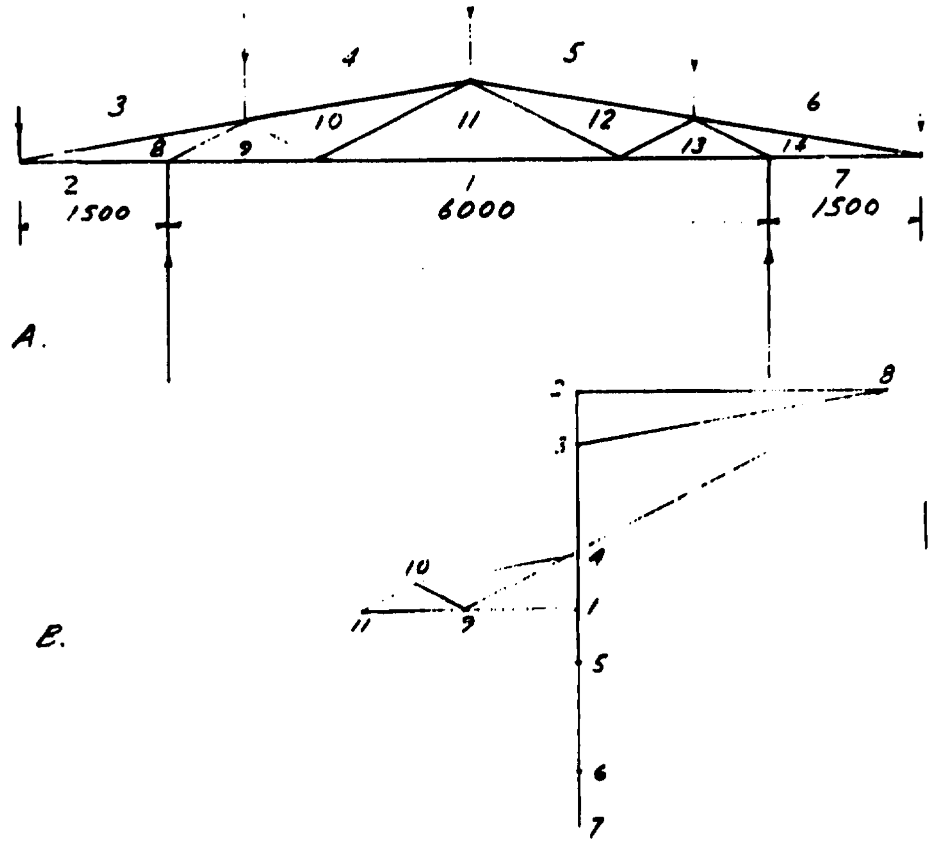


Fig 3. 6m SPAN • 10° PITCH CANTILEVER TRUSS

SCALE	DRAWN	
DATE.	APPROVED	

4. As large a scale as possible should be used. Careful drawing at a scale of 1:5 will permit direct scaling of member dimensions. At this scale overall drawing must be accurate. Roof pitches should be set out on the drawing by calculated tangents, rather than setting angles directly on the draughting machine or adjustable set square.

5. This is fully explained in textbooks of structural theory, and followed in Figs 2 and 3. Either letters or figures may be used; the use of figures here is no more than the author's personal preference.

6. Loads applied to the roof are assumed to act at the "nodes" or "panel points" only. These are taken to be (LL+DL) x (truss spacing) x (hor. distance between centres of adjacent panels). This last is most conveniently scaled. Strictly, ceiling loads should be calculated and applied to the bottom chord but this adds little to the precision of the analysis in ordinary cases and considerably complicates the analysis. Also the result of not doing so is slightly conservative.

   Strictly, the effect of slope on roof dead load should be allowed for. Again, with flat pitches this effect is small up to around 25°. The effects of neglecting this are shown in Table 2.

Roof Pitch Degrees	Error in dead load
0	0
5	0.4%
10	1.5%
15	3.5%
20	6.4%
25	10.3%
30	15.5%

Table 2. Error in Neglecting Pitch Effect on Dead Load

However, in practice, the steeper the roof, the less it is possible to stack on top of it, for the simple reason that things slide off steep roofs. So the theoretical inaccuracy gets cancelled out by the practicalities. In fact this effect is allowed for in most loading codes.

In the analysis, quite small scales may be used. There is not much point in being more precise than around 5-10kg = 50-100 N.

7. The numbers of nails are calculated from the "pair" values, that is one nail as drawn equals a nail on each face of the truss as constructed.

Regardless of how small some calculated forces may be, a minimum of 3 nails should be put into each side of each joint. The load and force analysis is after all a fairly crude approximation of the real world. Workmen climb around the structure, various things get stacked on or hung from roof structures and a reasonable minimum joint strength should be provided. Apart from anything else, the trusses have to be handled and transported and should not suffer damage at this stage. In very soft timbers, 4 nails should be the minimum.

8. The truss analysis is performed assuming that loads are concentrated at the panel points. In practice they are transferred through purlins. In architect designed structures these positions may be designated. In most cases they are not, and the purlins are placed according to the experience (or lack of it) of the carpenter. In the worst case this results in a rafter bending moment of $\frac{WL}{8}$. In practice a rafter bending moment of $\frac{WL}{12}$ may be used, and this has been borne out by experience.

On the other hand, classical analysis shows no bending moment at the heel joint. In practice, in timber trusses there does exist a considerable bending moment at this point. The simplest way to make allowance for this is to follow A.S. 1720, Table 4.8.4.5. and increase the number of fixings at the heel joint by the following amounts:

Roof pitch - degrees	Increase in heel joint fastening percent
less than 14	18
14 to 18	25
18½ to 22½	33
23 to 24½	43
25 and over	54

(Adapted from Table 4.8.4.7, A.S. 1720)

<u>Table 3. Increase in Heel Joint Fastening with Roof Pitch</u>

A further simplification which works without too much error concerns design for wind loading in moderate wind velocity areas.

Wind loadings act normal to the roof surface, not vertically. However, if one examines the situation for light weight roofs and considers:

(a) Vertical component of wind load minus dead load.

(b) Allowable short term stress for timber is 33% greater than long term stress.

It is found that the DL + LL stress is very nearly (-1) times the WL (vert) - DL stress. The useful thing about this is that only one force analysis is necessary, but the design is done for the worst load direction case, that is compression for truss members and tension for plate connections.

Note that there are several restrictions on the usse of this simplification.

(i) It should not be used for spans over about 12 m due to the actual asymmetrical disposition of wind loads.

(ii) It should not be used on pitches over 30°.

(iii) It applies only to light-weight roofs.

(iv) It should only be used in moderate wind velocity areas.

9. The truss drawing should show all details required for fabrication including:

- End cut angles for rafters and web members
- Member lengths for chords and webs
- Setting out positions
- Plate sizes and positions
- Number of nails in each part of each plate

Where possible standard plate positioning details should be used, shown in the drawings in this report.

Also show any special design features, e.g. anchorage if different from standard, bottom chord bracing if in a building without a ceiling, such as a garage.

A scale of nail loads as shown in Fig. 4 will permit the number of nails required in each joint to be read directly from the force diagram. The transparent plastic nail plate template allows suitable sized plates to be positioned and drawn rapidly and acurately.

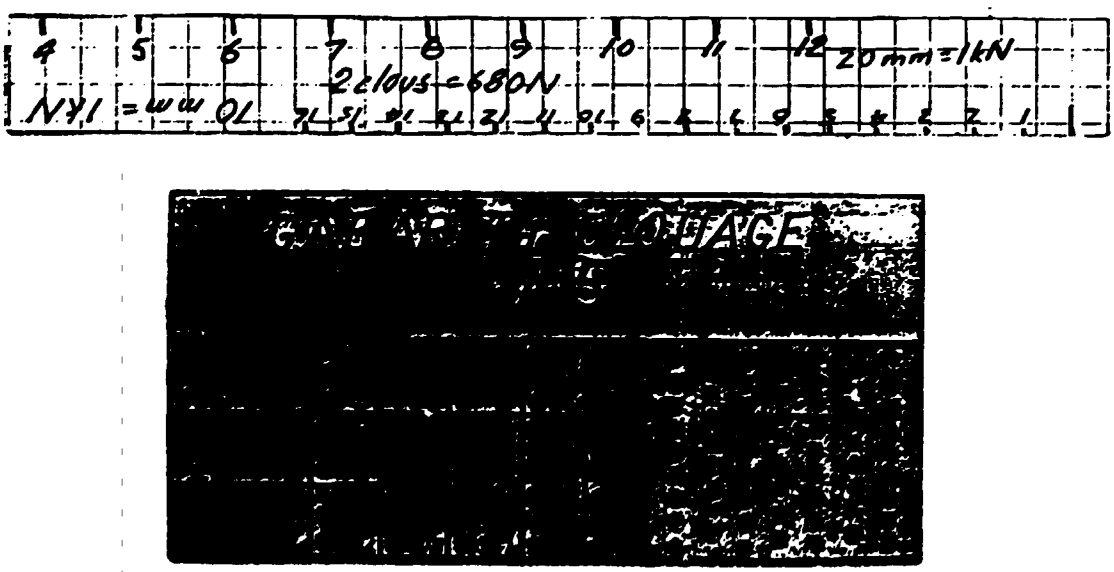


Fig. 4. Nail Number Scale and Nail Plate Drawing Template

5. SELECTION OF TIMBER FOR ROOF TRUSS MANUFACTURE

Timber roof trusses should above all be economical, that is to say they should give value for money spent in:

Structural adequacy
Ease of erection and fixing
Durability

From the manufacturer's point of view, the timber should be:

Readily available
Comply with design strength requirements
Straight, true, uniformly dimensioned
Easy to treat, if necessary, or durable
Easy to plane, saw and nail
Cheap

No one ideal timber exists. Any combination of desirable properties will push the price of a species up, making it less than ideal. Compromises must be made in the light of local circumstances.

The seventy Cameroon species described in the CENADEFOR booklet "Bois du Cameroun" have had their strength groups allocated according to information made available by UNIDO. These are given in Annexe C. Hardwood grading rules for structural purposes (essentially a condensation of A.S. 2082 "Visually Stress Graded Hardwood for Structural Purposes") are given in Annexe D. As described earlier in this report, most of the timber seen in Cameroon by the author would comply with 60% structural grade. Nevertheless, fabrication staff should be familiar with the grading rules and the grade requirements for the designs being fabricated and must ensure that under-grade timber is not used.

Table 4 shows the relationship between strength group, structural grade and stress grade of the pieces.

Remember that:

Strength Group is an inherent quality of the species.

Structural Grade describes the maximum defects permitted in any single piece of timber - knots, wane, slope of grain etc.

Stress Grade a combination of these two determines how much load can be put on a particular piece of timber.

Strength Group	Structural Grade			
	No. 1-75%	No. 2-60%	No. 3-48%	No. 4-38%
S 1	F 27	F 22	F 17	F 14
S 2	F 22	F 17	F 14	F 11
S 3	F 17	F 14	F 11	F 8
S 4	F 14	F 11	F 8	F 7
S 5	F 11	F 8	F 7	F 5
S 6	F 8	F 7	F 5	F 4

Table 4. Relationship between Strength Group Structural Grade and Stress Grade

No details are given of the "SD" grouping. It is considered premature at this stage, since drying of timber is hardly practiced in Cameroon for structural purposes, and also trade practice tends toward the use of green hardwood for roof trusses, due to the much greater ease of nailing in dense species and the possibility of drying in situ in a constrained situation. The author is aware of numerous arguments against this practice, but maintains his position on practical grounds.

Joint strengths, that is nail holding power, and localised shear at joints are not dependent on grade, since the assumption, and good practice are that joints are only made in clear wood. A separate "J" grouping of species is therefore made. This is given in A.S. 1720 for Australian species, and in Annexe C for Cameroon species.

A recent amendment to A.S. 1720 gives the following joint classification for unseasoned timber:

Table 5. Joint Strength Grouping

Basic density kg/m^3 at 12% m c	Joint Group	Basic lateral load for 3,15 mm dia. nail - N
750	J 1	490
600	J 2	385
415	J 3	275
380	J 4	195
310	J 5	150
250	J 6	110

For the whole table in this amendment, the expression

$P = 0,162\ (D-100)(d^{1,5} - 1)$ is a fair approximation,

where:

P = Load per nail, N

D = Basic density of wood, kg/m^3

d = Diameter of nail, mm

For steel side plates, an increase in load of 25% is permitted (A.S. 1720 clause 4.2.1.2.(e).

6. ROOF TRUSS DESIGNS

A series of designs suitable for Cameroon conditions is given in Annexe E.

These have been designed for the following conditions:

Timber: Stress grade F 11 or better
Joint group J 3 or better

Commonly available timbers and their grade requirements to meet these requirements are shown in Table 6.

Designs are given for:

- Monopitch, $7\frac{1}{2}^{o}$ pitch, 1 m cantilever both ends
  spans 4 m 6 m 8m

- Dual pitch, 10^{o} pitch, 1 m cantilever both ends
  spans 6 m 8 m 10 m

- Covering: aluminium or corrugated galvanised steel sheets

- Spacing : 1.5 m maximum. This is suitable for 40 x 80 purlins

The designs are prepared for F 11 timbers with J 3 nail holding properties. Table 6 shows the timbers commonly available in Cameroon together with their S and J groupings (extracted from Annexe C) and the grade described in Annexe D required to reach F 11 and F 8 stress grades.

The design loadings are taken as 0.25 kPa live load and 0.25 kPa dead load, a total of 0.5 kPa (50 kg/m^2).

The basic nail load has been taken as 340 N = 34 kgf in accordance with the recommendations of Lumber-lok N.Z. Ltd. for 3.15 x 30 mm nails.

Table 6. Truss Construction Species and Grades

Name	Ref.	S	J	Grade Required For F 11	F 8
Bilinga	12	S5	J2	75%	60%
Iroko	28	S5	J3	75%	60%
Movingui	34	S5	J2	75%	60%
Olon	40	S6	J4		75%
Frake	32	S7	J4	Not suitable	
Eyong	23	S4	J2	60%	48%
Bibolo	16	S6	J4		75%
Sapelli	45	S4	J3	60%	48%
Sipo	46	S5	J3	75%	60%
Kossipo	29	S5	J3	75%	60%
Acajou	2	S6	J2	-	75%
Ekop	36,61,66	S6	J3	-	75%
Ilomba	27	S7	J4	Not suitable	
Moabi	33	S4	J2	60%	48%
Eucalyptus *	-	S4	J3	60%	48%

* From A.S. 1720 Tables 4.1.1 and B1

REFERENCES

1. Francis, C.R. "A Trussed Rafter System" DP/ID/SER. A/353 23 March 1982 UNIDO, Vienna (English, French)

2. Francis, C.R. "Strength Grouping of Timber" IO/R. 173 5 September 1985 UNIDO, Vienna

3. ------ . SAA Timber Engineering Code. A.S. 1720-1975 Standards Association of Australia, 80 Arthur Street, North Sydney. N.S.W.

4. Bolza, Eleanor & W.G. Keating 1972 "African Timbers - the Properties, Uses and Characteristics of 700 species" Division of Building Research, C.S.I.R.O. Melbourne.

ANNEXE A

11.04 **Consultant en conception de charpentes et autres constructions en bois**

Durée 3 mois

Tâches Le Consultant aura pour tâche de concevoir et surveiller la production de prototypes d'une série de charpentes (et aussi dans la mesure du possible d'autres constructions simples en bois pouvant être produites en usine et/ou vendue en "kit" pour assemblage sur le site.

A ce titre, il devra notamment :

- étudier les types de charpentes simples de petite et moyenne portée utilisées couramment au Cameroun pour des logements, entrepôts, garages, ateliers, étables, et bâtiments administratifs en zones rurales ;
- étudier les DTU existantes et/ou les cahiers de charges ;
- étudier les marchés de l'Etat pour la fourniture de charpentes ;

Basé sur les informations recueillies, il devra :

- établir les spécifications des produits à être conçus (portée, charges, etc...) ;
- concevoir ces produits et préparer les plans techniques d'exécution ;
- surveiller la production de prototypes ;
- établir un programme d'essais de ces prototypes à l'Ecole Nationale Supérieure Polytechnique à Yaoundé ;
- former des contreparties dans ces tâches ;
- rédiger un rapport contenant les justifications de son choix de paramètres, tous les dessins et plans nécessaires pour une production en petites séries ainsi que la liste des matières premières.

Ce rapport contiendra aussi des recommandations adressées au CENADEFOR et au Ministère de l'Urbanisme et de l'Habitat sur les aspects d'utilisation du bois dans la construction.

<u>Qualifications requises</u> : Ingénieur, technicien du bois ou Architecte ayant une longue expérience dans la conception d'ouvrages d'art et/ou constructions en bois.

Familiarité avec les bois tropicaux et les conditions des pays en développement désirables.

<u>Connaissances linguistiques</u> : Français souhaitable, Anglais acceptable.

ANNEXE B

E. F. C.
SCIERIE
B.P. 22
SANGMELIMA

TARIF SYNDICAL DES BOIS DEBITES T.T.C
D'APRES ARRETE N° 11 MINCI/DPPX/SDP/P2
DU 10 MARS 1984

-:-:-:-:-:-:-:-

ESSENCES VISEES PAR LE PRESENT ARRETE

COFFRAGE	AYOUS - FRAKE - EYONG - EDZIL - BONGO - ANGONGUI-DIVERS
CHARPENTE	ODOU - ANGUEUK - ATUI - TALI - SIKONG - NIOVE - MOUDOUGOU - NKANANG - EKOP - ADOUM
MENUISERIE CARROSSERIE	IROKO - BILINGA - MOVINGUI - ALBIZIA - MEKULUNGU
EBENISTERIE	SIPO - SAPELLI - BIBOLO - ADZAP - LANDA - ACAJOU - KOSSIPO

DIMENSIONS STANDARD

LONGUEURS	EPAISSEURS	LARGEUR				
DE 4 à 6 m	0,03		0,15	0,20	0,25	0,30
DE 4 à 6 m	0,04	0,08	0,15	0,20	0,25	0,30
DE 4 à 6 m	0,06	0,06	0,15	0,20	0,25	0,30
DE 4 à 6 m	0,08	0,08	0,15	0,20	0,25	

QUALITE	UNITE	PRIX PUBLIC T.T.C. EN F CFA	
		DIMENSIONS STANDARDS	EPAISSEUR 0,02
COFFRAGE TOUT VENANT	M3	60 676	66 053
CHARPENTE TOUT VENANT	M3	66 061	71 453
MENUISERIE . CARROSSERIE	M3	71 453	76 841
EBENISTERIE	M3	86 285	91 672

MAJORATION POUR COMMANDES SPECIALES

1° DIMENSIONS NON STANDARD : + 10 % DU TARIF DES DIMENSIONS CI-DESSUS
2° LONGUEURS FIXES : + 10 % DU TARIF STANDARD CI-DESSUS
3° COMMANDES PORTANT SUR LES ESSENCES AUTRES QUE CELLES ENUMEREES ET CLASSEES CI-DESSUS : + 2.000 F CFA/M3

ANNEXE C

Physical and Strength Properties of Cameroon Timbers

This section is based on the CENADEFOR booklet "Bois du Cameroun", pages 16 to 28 of which are reproduced on the left hand side of the page, and BOLZA and KEATING "African Timbers - the properties, uses and characteristics of 700 species" (CSIRO, Melbourne 1972). Bolza and Keating give strength grouping according to the Australian system, density in coded form, durability in coded form and lyctus borer susceptibility of sapwood. From the density given, and also from the density given by CENADEFOR a joint (J) strength grouping has been assigned. Where difficulty in nailing, e.g. splitting or a requirement for pre-boring exists an exclamation (!) has been added to the J group.,

In all cases a conservative approach has been adopted, the lowest strength group of those quoted (and there are frequently several) has been given, and the lowest density quoted has been used in assigning a J group.

The following is the durability classification as given by Bolza and Keating:

> "The timbers have been assigned to one or other of four classes. Whilst it is not possible to be precise in this area, the following definitions were adopted as being applicable when describing resistance to decay of the heartwood in ground contact under average conditions:
>
> Class 1 : Timber of the highest natural durability which may be expected to have a life of at least 25 years and sometimes up to 50 years.

<u>Class 2</u> : Timber of high natural durability which may be expected to have a life of about 15-20 years.

<u>Class 3</u> : Timber of only moderate durability which may be expected to have a life of about 8-15 years.

<u>Class 4</u> : Timber of low durability which may last from 1-8 years. These timbers have about the same durability as untreated sapwood which is generally regarded as class 4 irrespective of species.

For conditions significantly different from that of moderate to high decay hazard as represented by ground contact, the life expectancy of the classes would, of course, depart markedly from those given by the definitions. However, the relative durabilities might by expected to be maintained".

Lyctus borer susceptibility of sapwood is indicated by "S" for susceptible and "N" for non-susceptible.

There have been numerous cases of doubt in identification due to changes in botanical nomenclature and the wide variation in application of vernacular names. Bolza and Keating themselves comment on this difficulty. The B and K page number pertaining to both vernacular and botanical name has been shown in the appropriate squares. Where these agree identification is reasonably positive, but where they differ, there is some doubt. In such cases, or where a timber comprises several species, the lowest rating has been given for all four strength and resistance ratings.

No attempt has been made to follow up the references, and some groupings may be overly conservative. Rectification of this could be a useful area of later local library and practical research.

The extracts from B & K's monograph used for this section are held by CENADEFOR.

CARACTERISTIQUES TECHNIQUES DES PRINCIPAUX BOIS DU CAMEROUN

Nos	NOMS - PILOTES ET VERNACULAIRES	NOMS SCIENTIFIQUES	FAMILLES	POIDS DU M³ DE GRUME A L'ETAT VERT/KG	DENSITE A 15 % D'HUMIDITE	TRAVAIL ET REMARQUES	UTILISATIONS	Strength Group	Joint Group	Durability	Lyctus sus.
1	ABALE ou ESSIA (Abing) 164	Combretodendron africanum (Welw. ex Bth & Hok. f.) Exell 164	Lecythidaceae		0,75 à 0,85	Difficile à travailler - Fendil - Tranchage facile - Placage rubané et décoratif.	Charpente - Menuiserie - Placage ; Contre-plaqué.	S 4	J 1	2-3	N
2	ACAJOU D'AFRIQUE (Ngollon) 406	Khaya ivorensis A. Chev. 406	Meliaceae	650 à 750	0,47 à 0,60	Travail facile, beau poli - Bois élastique et résilient.	Ebénisterie, carrosserie, bateaux de plaisance - Menuiserie soignée, hélices d'avion - Le ngollon, vu sa facilité de pliage à l'eau chaude, est employé dans la fabrication des coques de luxe.	S 6	J 2	3	S
3	ALEP (Oman) 216	Desbordesia Glaucescens	Irvingiaceae	1 200 à 1 300	1,1 à 1,2	Contrefil sur mailles et sur dosses.	Travaux publics et Ports - Traverses de chemin - de - fer.	S 1	J 1	2	S
4	AGBA ou TOLA (Alo) 357	Gossweilerodendron balsamiferun (verm.) Harms 357	Caesalpiniaceae	750 à 850	0,46 à 0,51	Travail facile - Durable, latter aussitôt après sciage - Résiste aux insectes, mais demande étuvage (oléorésine).	Menuiserie extérieure, agencements - Ebénisterie - Placage - Contreplaqué - Construction navales - Utilisation spéciale : cuve tonnellerie.	S 7	J 3	2-3	S
5	AIELE (Abel) 121	Canarium Schweinfurthii Engl. 121	Burseraceae	750 à 850	0,50 0,55	Travail facile en contreplaqué - Sciage plus difficile.	Ebénisterie Contreplaqué - Utilisation spéciale : Caisserie.	S7.	J 3	4	S
6	ANGUEUK 497	Ongokea gore (Hua) Pierre 497	Olacaceae	900	Lourd	Sciage facile - Rabotage facile et se polit très bien - Fente à l'outil facile - Clous et vis tiennent bien - Tenons et mortaises résistent parfaitement bien - Gros effort à l'arrachement, 7,000 kg sur un tirefond de voies ferrées.	Menuiserie et construction, outillage. l'Allemagne l'utilise en madriers.	S 3	J 1	2-3	S
7	AFRORMOCIA (ASSAMELA) 521	Pericopsis elata Harms 521	Papilionaceae	1 000	0,70 à 0,80	Bois très résistant aux pourritures et aux termites - Séchage facile, sans déformation.	Construction navale, menuiserie extérieure, escalier, parquets, etc.	S 3	J 2	1	S
8	WENGE (Awong) 447	Milletia laurentii - De Wild 447	Papilionaceae	1 100 à 1 200	0,80 à 0,95	Travail facile, très durable, très bel aspect, poli difficile.	Ebénisterie fine, tabletterie, brosserie, placage.	S 3	J 2	1-2	S

Nos.	NOMS - PILOTES ET VERNACULAIRES	NOMS SCIENTIFIQUES	FAMILLES	POIDS DU M³ DE GRUME A L'ETAT VERT/KG	DENSITE A 15 % D'HUMIDITE	TRAVAIL ET REMARQUES	UTILISATIONS	Strength Group	Joint Group	Durability	Lyctus Sus.
9	AZOBE (Bongossi ou Okoga) 422	Lophira alata Banks ex Gaertn 422	Ochnaceae	1 000 à 1 300	0,95 à 1,1	Inputrescible, résistance remarquable (12 ans à l'eau de mer), résistance relativement moindre aux chois violents, transmission remarquable des chocs et vibrations ; l'aubier se laisse lentement attaquer par les insectes.	Charge - Carrosserie - Traverses de chemin de fer - Travaux hydrauliques - Utilisation spéciales : guides de mines.	S 2	J 1	1	N
10	BAHIA (OU ELOLOM) 452	Mitragyna ciliata Aubrev. et Pellegr. 452	Rubiaceae	800 à 850	0,52 à 0,60	Travail facile - Bon fini, ne joue pas - Les grumes à cœur spongieux se travaillent plus facilement - Se conserve mal en grumes - Sciage nécessitant traitement.	Menuiserie - Ebénisterie - Moulure - Utilisation spéciale : baguettes, cadres, cuves chimiques, séparation d'accumulateurs.	S 6	J 3	3-4	S
11	MANSONIA/BOTE (Nkoul) 437	mansonia altissima A. Chev. 437	Sterculiaceae	900	0,60 à 0,70	Remplace le noyer, mais doit être teinté - Très connu en Angleterre (mansonia)	Menuiserie - Ebénisterie - Placage Contreplaqué - Carrosserie.				
12	BILINGA (Akondok) 465	Nauclea trillesti Merill Nauclea Diderichii 465	Rubiaceae Rubiaceae	950	0,70 à 0,90	Sciage facile - Rabotage assez facile - Polissage difficile mais done un beau poli - Fente à l'outil radiage difficile, tangentielle facile - Assemblage résistant, clous et vis tiennent bien - Tenue du bois débité - Se contracte un peu mais ne gauchit pas, employé sec. Prendre précaution pour éviter qu'il ne se fendille légèrement au séchage	Menuiserie - Ebénisterie - Moulures - Huisseries - Placage - Traverses de chemin de fer - Travaux hydrauliques - Très recherché dans l'ébénistérie de luxe pour sa belle couleur jaune d'or - Fonce à l'air et devient jaune doré ; remplace le citronnier dans l'ébénisterie - Utilisation spéciale : parquet, tournage.	S 5	J 2	1	S
13	BOSSE (Ebangbemva) 359	Guarea cedrata (A. Chev.). Pellegr. 359	Meliaceae	900	0,55 à 0,65	Séchage rapide - Sciage très facile mais peu de contrefil - Fente à l'outil facile mais non droite - Brunit à l'air - assemblage tenons et mortaises résistant - Toupillage bon - Colle en placage - Clous et vis tiennent bien, mais peuvent provoquer quelsues fentes - Tenue du bois - bonne.	Menuiserie d'intérieur - Ebénisterie fine - Utilisé en panneauxn en placage, en bois de meubles massifs, en menuiserie de luxe, fabrication d'articles de bureau et d'outillage de précision, canots de plaisance Utilisation spéciale : boîte à cigares - Siège.	S 6	J 3	2-3	S

Nos	NOMS - PILOTES ET VERNACULAIRES	NOMS SCIENTIFIQUES	FAMILLES	POIDS DU M³ DE GRUME A L'ETAT VERT/KG	DENSITE A 15 % D'HUMIDITE	TRAVAIL ET REMARQUES	UTILISATIONS	Strength Group	Joint Group	Durability	Lyctus sus.
14	BUBINGA (Essingang) 367	Guibourtia tessmannii J. Leonard et autres 367	Caesalpiniaceae	900 à 1 000	0,80 à 0,95	Sciage lent - Rabotage facil et donne un bon poli - Fente à l'outil facile - Assemblages tenons mortais tiennent bien ; tenue du bois débit : bonne.	Convient surtout pour l'ébénisterie - Fabrication des meubles, salle à manger - Fabrication pianos pour lamaison Peyel à Paris - Art décoratif - Placage - Utilisation spéciales : Brosserie, coutellerie.	S 2	J 1	2	N
15	DABEMA (Atui) 543	Piptadeniastrum africanum Brenan 543	Mimosceae	900 à 960	0,65 à 0,75	Travail assez faciule - Bonne tenue - Sciure irritante - Résiste aux termites.	Menuiserie - Charpente - Parquets - Carrosserie - Traverses de chemin de fer - Construction navales	S 5	J 2	2-3	S
16	DIBETOU (Bibolo) (Noyer du Gabon) 426	Lavoa Trichilioides Harms 426	Meliaceae	750	0,50 à 0,55	Se travaille bien - Durables - Souple - Très apprécié - (Parfois appelé acajou gris) prend parfaitement la teinture - Résiste à la compression et la Flexion comme le noyer de choix, mais ne résiste à la traction	Carrosserie - Donne un meilleur rendement au débitage que le noyer de France - Employé généralement en ébénisterie, ménuiserie, tranchage déroulage - Placage.	S 6	J 4	2-3	S
17	DIFOU (Ossel ou Ossié) 461	Morus mesozyngia Stapf 461	Moraceae	1 100	0,70 à 0,85	Travail facile - Beau poli.	Ebénisterie - Tabletterie.	S 1	J 2	3-4	S
18	DOUKA (Douka) 656	Dumoria africana A. Chev. 656	Sapotaceae	900 à 1 000 à	0,65 à 0,75	Makoré, mais plus colore veine	Ebénisterie, placage	S 4	J 2	1	S
19	DOUSSIE (Mbanga et Edoussié) 19	Afzelia pachyloba Harms Afzelia africana Smith (W. Af.) Afzelia bipindensis Harms 19 16	Caesalpiniaceae	1 100 à 1200	0,70 à 0,90	Sciage assez difficile mais travail facile - impubrescible - Résiste aux vapeurs chimiques. Ne joue pas - Aubier à éliminer - clouage difficile - Polissage, vernissage et collage facile - Excellente conservation.	Menuiserie extérieure - Charpente - Parquets - Traverses de chemin de fer - Constructions navales. Cuves - Travaux hydrauliques, - Utilisation spéciales : Cuves chimiques - Excellent pour les parquets d'usure.	S 3	J 2	1	N
20	EBENE (Mevini)	Dyospiros SPP 234_235_236 239	Ebenaceae	1 300 à 1 400	1,10 à 1,20	Travail assez facile mais rabotage difficile donne un poli excellent - Tenue du bois dé-	Marquetterie - Brosserie - Coutellerie - Décoration - Sculpture - Tournage - Utilisation	S 5	J 1	4	S

Nos.	NOMS - PILOTES ET VERNACULAIRES	NOMS SCIENTIFIQUES	FAMILLES	POIDS DU M³ DE GRUME A L'ETAT VERT/KG	DENSITE A 15 % D'HUMIDITE	TRAVAIL ET REMARQUES	UTILISATIONS	Strength Group	Joint Group	Durability	Lyctus sus.
						bité très bonne.	spéciales : Dièses de piano. Jeux, instrument de musique, manches d'outils				
21	E B I A R A (Abem ou Essabem) 80	Berlinia bracteosa Benth et Berlinia grandiflora (Vahl)Hulth et Dalz. 80 82	Caesalpiniaceae	900	0,67 à 0,73	Résiste à la lumière contrairement à la plupart des bois africain	Menuiserie extérieure - Ebénisterie.	S 4	J 2	2-3	S
22	EMIEN (Ekouk) 38	Alstonia congensis Engl. 38	Apocynaceae	500 à 600	0,40 à 0,50	Se travaille bien - Peu résistant - Fente à l'outil très facile - Clous et vis tiennent bien - Tenue du bois débité : est sujet - l'échauffement.	Menuiserie légère - Allumettes - Placage - Caisserie - Les Africains l'utilisent pour la fabrication de statuettes et la confection des sièges	S 7	J 5	4	S
23	EYONG 265	Sterculia oblonga Mast 265	Sterculiaceae		0,72	Se travaille assez bien, néanmoins un peu gêné par le contrefil - les assemblages sont résistants - Durable.	Menuiserie extérieure, vu sa qualité de résistance aux intempéries.	S 4	J 2	3	N
24	FARO (Nsou)	Daniellia thurifera Benn 212	Caesalàpiniaceae	650 à 650	0,40 à 0,60	Se conserve mal.	Menuiserie - Utilisation spéciales : Caisserie	S 7	J 4	4	S
25	FRAMIRE (Lidia, Black Afara) (Emri) 640	Terminilia ivorensis A. Chev. 640	Combretaceae	750 à 850	0,45 à 0,60	Travail facile - Ne joue pas - Collage, vernissage et peinture faciles - A débiter sur quartier - Se déroule bien.	Menuiserie intérieure - Construction - Menuiserie apparente - Ebénisterie - Contrepaqué.	S 5	J 4	2	S
26	FROMAGER (Doum) 138	Ceiba pentandra 138	Bombacaceae	500 à	0,21 à 0,45	Se travaille bien - Peu durable - Cassant - Compressible - Bois à grand rendement - A traiter après abattage.	Caisserie locale - Utilisation spéciale pâte à papier - Boîtes.	<S 7	<J 6	4	S
27	I L O M B A (Eteng) 572	Pycnantus Angolensis Exell 572	Myristicaceae	700 à 750	0,45 à 0,60	Doit être traité après abattage.	Moulures et contreplaqué - Emballages.	S 7	J 4	4	S

Nos.	NOMS - PILOTES ET VERNACULAIRES	NOMS SCIENTIFIQUES	FAMILLES	POIDS DU M³ DE GRUME A L'ETAT VERT/KG	DENSITE A 15 % D'HUMIDITE	TRAVAIL ET REMARQUES	UTILISATIONS	Strength Group	Joint Group	Durability	Lyctus sus.
28	IROKO (Abang) 147	Chlorophora excelsa (Welw.) Benth 147	Moraceae	950 à 1 050	0,65 0,76	Travail facile - Tabotage un peu gêné par le contrefil - Fente facile - Assemblage résistant - Clous et vis s'enfoncent et tiennent bien - Résiste à l'eau et aux insectes - Cœur parfois pierreux - Excellent bois, beau fini connu et apprécié - Peut remplacer le Teck Java et Siam.	Fabrication de membrures pour canots - Menuiserie intérieure et extérieure - Parquets : Traverses de chemin de fer - Construction navales - Utilisations spéciales - barattes, bordées de pont ; remplace le chêne dans la menuiserie de charpente et l'ébénisterie.	S 5	J 3	1 - 2	S
29	K O S I P O (Atom-Assié) 259	Entandrophragma candollei Harms 259	Meliaceae	850 à 950	0,60 à 0,80	A débiter de préférence plein quartier - Aubier inutile - Se fent - Joue - Assez nerveux.	Menuiserie - Ebénisterie - Placage.	S 5	J 3	3	S
30	KOTIBE (Owoé-Ovoué) 468 - 470	Cistanthera Papaverifera A. Che. 470	Tiliaceae	950 à 1 050	0,70 à 0,85	Travail assez facile - très durable Beau poli.	Charpente - Carrosserie - Manches d'outils.	S 4	J 2	2	S
31	LANDA (Landa) 273	Erythroxylum mannii Oliv. 273	Erythroxylaceae	800	0,62 à 0,67	Travail sans difficultés malgré fibre ondulée et contrefil, rabotage facile - Vis et clous tiennent bien - Collage. vernissage et peinture faciles - Similaire au chêne ordinaire.	Est employé en menuiseries extérieures, en ébénisterie, en placage.	S 4	J 2	2	N
32	LIMBA (Akom) (Fraké) 646	Termipalia superba Engl. et Diels 646	Combretaceae	800 à 900	0,45 à 0,75	Sciage très facile - Rabotage assez facile - Pas nerveux, Fente à l'outil peu facile - Tenons et mortaises se taillent facilement et tiennent bien - Clous, vis faciles à enfoncer, tiennent bien - Effort à l'arrachement sur tirefond de voies ferrées 2 600 kg. Le coeur suit les destinations du noyer : l'aubier (les 213 du bois) celles du chêne. Le traitement des sciages est nécessaire.	Contreplaqué - Menuiserie - Ameublement - Magasins - Parquets - tonnellerie.	S 7	J 4	4	S
33	MOABI (Njabi) 70	Baillonella Toxisperma Pierre 70	Sapotaceae	1 000 à 1 100	0,80 à 0,90	Sciage assez facile - Rabotage très facile - Fente facile - Assemblage tenons, mortaises parfaits, clous et vis tiennent bien - tenue du bois débité : bonne.	Belles menuiseries et ébénisteries - S'utilise également en parquets, escaliers, moulures, encadrements portes et fenêtres - Remplace avantageusement le chêne dans tous ses emplois dans les confections de meubles et de matériel roulant : constructions na-navales et même grosses charpentes - Placage, contreplaqué - Travaux hydrauliques.	S 4	J 2	1	N

Nos.	NOMS - PILOTES ET VERNACULAIRES	NOMS SCIENTIFIQUES	FAMILLES	POIDS DU M³ DE GRUME A L'ETAT VERT/KG	DENSITE A 15 % D'HUMIDITE	TRAVAIL ET REMARQUES	UTILISATIONS	Strength Group	Joint Group	Durability	Lyctus sus.
34	MOVINGUI (Eyen) 242	Distemonanthus Benthamianus Baill 242	Caesalpi-Piniaceae	850 à 950	0,65 à 0,82	Sciage assez facile aux scies verticales ou horizontales, difficile aux scies à ruban - Rabotage assez difficile - Nécessité d'outils parfaitement affûtés - Fente à l'outil radiale difficile. Tangentielle facile - Assemblage difficile à faire mais très solide - Clous et vis difficiles à enfoncer mais tiennent bien - Tenue du bois bonne - Peu fendif - Résiste aux fortes compressions exactement comme l'acacia - La flexion est, au choc comme le chêne moyen ; la traction comme le chêne de choix.	Joli bois pouvant servir en ébénisterie, menuiserie charpente et charronnage pour les raies de voitures, placage. parquets - Employé dans les confections de chassis, de montants et membres de canots de plaisance - Décoration d'appartements.				
35	MUKULUNGU (Elang) 65	Austranella congolensis A. Chev. 65	Sapotaceae	1 000 à 1 100	0,90 à 1,00	Résiste aux insectes - Beaux placages sur quartier - Très résistant.	Menuiserie - Ebénisterie - Placage - Carrosserie - Parquets - Constructions navales - Travaux hydrauliques - Utisations spéciales : anti-acide, marchepieds.	S 3	J 1 (1)	1	S
36	NAGA (variété d'Ekop) 98	Brachystegia Cynometroides Harms 98	Caesalpi-piniaceae	850	0,70	Travail facile - Beau fini - Assez nerveux.	Menuisene - Déroulage.	S 4	J 2	4	S
37	NIOVE (Mbonda) 608	Staudtia spilitata Warb. Staudtia Kamerunensis Warb. 608	Myristicaceae	900 à 1 000	0,85 à 1,00	Très résistant - Assez nerveux - Utilisé avec succès comme banquettes de wagons.	Menuiserie extérieure et intérieure - Carrosserie - Traverses de chemins de fer - Utilisation spéciale : manches d'outils.	S 2	J 1	1	N
38	OBOTO (Aborzok) 433	Mammea africana 433	Guttiferae	950	0,68 à 0,80	Fendif, gauchit, souvent difforme - Se tache par la résine.	Menuiserie intérieure et extérieure.				
39	OKAN (Adoum) 542	Cylicodiscus gabunensis Harms 542	Caesalpiniaceae 32	1 000 à 1 100	0,85 à 1,10	Travail difficile - Séchage délicat - Excellente résistance mécanique.	Excellent bois de construction lourde - Ponts - Platelage - Portes d'écluses - Traverses de chemin de fer.	S 3	J 2	1	S
40	OLON (Bongo) 320	Fagara heitzii Aubrév. & Pellegr. 320	Rutaceae	700 à 800	0,50 à 0,60	Tendre - Fin - Peu nerveux - Collage, vernissage et peinture faciles - Clous et vis tiennent bien.	Très apprécié en déroulage - menuiserie légère - Moulures - Contreplaquages.	S 6	J 4	4	S
41	OVOGA (Angalé-N'Gale) 551	Poga oleosa Pierre 551	Rhizo-phoraceae	850 à 950	0,45 à 0,60	Tendre et léger - Résistance mécanique faible - travail facile - Clous et vis tiennent bien - Collage aisé.	Menuiserie - Agencement - Placage Charpente - Caisserie.	S 7	J 4	3	N

Nos.	NOMS - PILOTES ET VERNACULAIRES	NOMS SCIENTIFIQUES	FAMILLES	POIDS DU M³ DE GRUME A L'ETAT VERT/KG	DENSITE A 15 % D'HUMIDITE	TRAVAIL ET REMARQUES	UTILISATIONS	Strength Group	Joint Group	Durability	Lyctus sus.
42	OZIGO (Assa - Mingoung) 197	Dacryodes Buettneri (Eng.) H.J. Lam 197	Burseraceae	750 à 850 à	0,50 à 0,60 à	Peut se comparer à l'Okoumé si bien traité - L'aubier s'abime, à préserver à l'abattage.	En déroulage, plus dur que l'Okoumé Estimé en coffrage, parquets, ameublement ordinaire.	S 4	J 3	4	S
43	PADOUK (Mbé) 569	Pterocarpus soyauxii Taub 569	Papilionaceae	900 à 1 000	0,65 à 0,80	Travail facile rabotage aisé - Fente à l'outil très facile Tenons et mortaises assez faciles à faire et résistants - Gros efforts à l'arrachement, 7 400 kg sur un tirefond de voies ferrées - Tenue du bois bonne, mais parait légèrement fendif.	Recommandé surtout pour l'ébénisterie, tabletterie en raison de son aspect rougeâtre - peut servir en menuiserie - placage, carrosserie - Agencement de magasin de luxe - Décoration d'appartements - Construction de wagons - Canots de luxe.	S 4	J 2	1-2	S
44	OBECHE (Ayous) 668	Triplochiton scleroxylon K.Schum 668	Sterculiaceae	600	0,35	Siage facile - Rabotage facile - Fente à l'outil très aisée - Tenons et mortaises faciles à faire et assez résistant - Clous et vis s'enfoncent bien - Tenue assez bonne - latter après sciage - Excellent pour contreplaqué - Peut remplacer le peuplier - Les insectes s'y attaquent moins et l'échauffement est plus rare.	Menuiserie légère, caisserie, contreplaqué - peut faire une bonne pâte à papier.				
45	SAPELLI 260	Entandrophragma cylindricum Sprague 260	Meliaceae	800 à 900	0,60 à 0,75	Sciage et rabotage très faciles - Poli beau fini - Assemblage facile et résistant - Très apprécié pour son contre-fil d'aspect rubané - Clous et vis tiennent parfaitement bien - Tenue du bois débité très bonne.	Employé en ébénisterie de luxe - Est employé également en menuiserie, verni ou ocré - Fabrication de meubles.	S 4	J 3	2-3	S
46	SIPO (Assié - Timbi) 264	Entandrophragma utilé Sprague (Dave & Sprague) 264	Meliaceae	750 à 850	0,55 à 0,68	Se travaille bien, tient bien - Beau poli - Vernissage facile - Prend bien la peinture et la teinte - Excellent bois parfois plus apprécié que l'acajou, quoique plus lourd.	Ebénisterie - Placage - Menuiserie - Agencement de magasins.	S 5	J 3	3-4	S
47	TALI (Eloum) 270 271	Erythrophleum ivorense A. Chev. et E. guineense G. Don 270 271	Caesalpiniaceae	1 000 à 1 100	0,80 à 1,10	Se travaille difficilement mais rabotage assez facile - Beau fini - Résiste à de très gros efforts à l'arrachement : 7 750 kg sur un tirefond de voies ferrées - Résistant à l'humidité et aux termites - Bois du genre Azobé avec lequel il entre en concurrence de bois durs. - Clous et vis s'enfoncent facilement - Toupillage facile.	A utiliser dans des marches d'escaliers et le parquet - Très grande résistance à l'usure - A employer en charronnage, en traverse de chemin de fer, matériel roulant, constructions navales, travaux de mines et travaux sous l'eau - Utilisation péciales : Ponts.	S 3	J 1	1	N

Nos.	NOMS - PILOTES ET VERNACULAIRES	NOMS SCIENTIFIQUES	FAMILLES	POIDS DU M³ DE GRUME A L'ETAT VERT/KG	DENSITE A 15 % D'HUMIDITE	TRAVAIL ET REMARQUES	UTILISATIONS	Strength Group	Joint Group	Durability	Lyctus sus.
48	LOTOFA (Nkanang) 643	Sterculia rhinopetala K. Schum. 613	Sterculiaceae	900	0,75 à 0,80	Facilité de travail - Beau fini - Plucheux - Séchage délicat - Qualité parfois mauvaise.	Charpente.	S 3	J 2	3	S
49	ZINGANA (Alen Elé) 444	Microberlinia Bisulcata A. Chev. 443	Caesalpiniaceae	1 100 à 1 200		Travail facile - Sciage facile - tranchage, polissage, vernissage aisés - Elastique et résistant aux chocs.	Décoration, tabletterie, articles de Paris - Ski, manches d'outils - Connu en placage sous le nom de ZEBRANO.	S 4	J 2	2	S
50	ABURA (Elolom) 454 452	Mitragyna Ciliata 452	Rubiacées	900 à 950	0,50 à 0,60	Assez faible durabilité naturelle légèreremnet désaffutant au sciage Existe en stations marécageuses	Déroulage - contreplaqué - sciage : menuiserie intérieure, baguettes et moulures carcasses et meubles	S 6	J 3	3-4	S
51	ANINGRE (Abam)	Aningeria Robusta	Sapotacées	850 à 950	0,50 à 0,60	Abrasif au sciage Faible durabilité naturelle Bonne imprégnabilité et bonne teinture.	Tranchage : placage ébénisterie Déroulage : placage sciage : ameublement teinte noyer				
52	AVODIRE (Asama) 671	Turracanthus africana 671	Méliacées	750 à 850	0,50 à 0,60	Sujet au bleuissement	Tranchage : placage ébénisterie sciage : menuiserie légère agencements intérieurs mobilier	S 6	J 4	4	S
53	DIANIA (Diania) 442	Celtis Tessmannü	Ulmacées	900 à 1000	0,65 à 0,80	A rapprocher de ohia, faible durabilité naturelle le, bois parfait s'imprègne mal	Déroulage : boîtes d'allumettes sciage : menuiserie intérieure diverses utilisations du du Frêne d'Europe	S 4	U 3	4	S
54	IATANDZA (Evouvous)	Albizia ferruginea 25	Mimosacées	900 à 1050	0,60 à 0,70	Bonne durabilité naturelle Poussières irritantes (éternuements)	Sciage : menuiserie intérieure charpente légère,agencement,caisserie	S 6	J 4	2-3	S
55	KOTO (Elok-Ayous)	Pterygota macrocarpa	Sterculiacées	850 à 950	0,55 à 0,70	Sensible aux attaques des champignons et des insectes	Tranchage : placage : Déroulage : placage Sciage : menuiserie intérieure ameublement				
56	MAKORE (Douka) 657	Tieghemella africana 656	Sapotacées	850 à 1025	0,60 à 0,75	Abrasif au sciage - Excellente durabilité naturelle; résistant à l'attaque des lyctus et termites	Tranchage : placage ébénisterie Déroulage : contreplaquée sciage : menuiserie int. et ext. Fonds de camions	S 5	J 3	1	S
57	LATI (Edjin, Edjil) 42	Amphimas sp 44-42	Césalpinacées	900 à 1000	0,70 à 0,80	Se pique et s'altère facilement, imprégn. nécessaire	sciage : menuiserie intérieure obligatoirement traitée.	S 4	J 2	4	S

Nos	NOMS - PILOTES ET VERNACULAIRES	NOMS SCIENTIFIQUES	FAMILLES	POIDS DU M³ DE GRUME A L'ETAT VERT/KG	DENSITE A 15 % D'HUMIDITE	TRAVAIL ET REMARQUES	UTILISATIONS	Strength Group	Joint Group	Durability	Lyctus sus.
						et bonne placages colorés imitation-wengé.					
58	OSSANGA (Sikon)	Pteleopsis Hylodendron 564	Combretacées	950 à 1050	0,70 à 0,80		sciage : parquets, grosse menuiserie de bâtiment ; traverses chemin de fer.	S 4	J 2	2-3	S
59	ONZABILI (Angonga) 55	Antrocaryon Klaineanum 55	Anacardiacées	800 à 900	0,60 à 0,70	Durabilité naturelle médiocre et très sujet à la piqûre ; traitement obligatoire avant utilisation	Déroulage : placage contreplaqué sciage : menuiserie intérieure moulure.	S 4	J 3	4	S
60	EVEUSS (Ngon) 413	Klainedoxa gabonensis 413	Irvingiacées		0,90 à 1,10	Pratiquement pas exporté en grumes	sciage : traverses de chemin de fer imprégnées.	S 2	J 1	1	S
61	EKABA (Ekop-ribi) 652	Tetraberlinia bifoliolata 652	Césalpiniacées	750 à 900	0,55 à 0,65	Les bois se distinguent difficilement de ceux des Andourg.	Déroulage : contreplaqué coisserie sciage : menuiserie intérieure charpente.	S 6	J 3	3	S
62	MAMBODE (Amonk)	Detarium macrocarpum	Césalpiniacées	850 à 1000	0,60 à 0,70	Préservation contre les piqûres de lyctus exigée pour les utilisations dans les sciages	Tranchage : placage, ébénisterie sciage : menuiserie intérieure aménagements.				
63	RIKIO (Assam) 672	Uapaca guineensis 675	Euphorbiacées	900 à 1100	0,70 à 0,80	Assez bonne durabilité nat. résistance à la pourriture, aux termites, bonne imprégnabilité bois silicieux + ou − désaffutant	sciage : menuiserie extérieure charpente, parquet, traverses.	S 4	J 3	2? 3-4	N
64	OHIA (Odon)	Celtis mildbraedii 144	Ulmacées	900 à 1000	0,75 à 0,85	Faible durabilité naturelle, imprégnabilité mauvaise	Déroulage : placage sciage : menuiserie intérieure ameublement.	S6	J3 (!)	4	S
65	MOAMBE JAUNE (Mfoo) 253	Enantia chlorantha 253	Annonacées	850 à 950	0,50 à 0,60		Tranchage : placage Sciage : menuiserie intérieure. moulures, aménagements intérieurs.	S6	J 4	4	S
66	NGANGA (Ekop-Nganga) 98? 511	Cynometra hankei 195?	Césalpiniacées	1100 à 1200	0,90 à 1,00	Poussières quelquefois irritantes.	Tranchage : placage ébénisterie Sciage : traverses de chemin de fer travaux hydrauliques parquet.	S 4	J2 (!)	3-4	S
67	BODIOA (Nondongon) 49	Anopyxis Klaineana 49	Rhizophoracées	950 à 1100	0,80 à 0,90	Durabilité naturelle médiocre, mais bonne imprégnabilité	Sciage : traverses de chemin de fer imprégnées - construction lourdes.	S 2	J 1	3-4	N

Nos.	NOMS - PILOTES ET VERNACULAIRES	NOMS SCIENTIFIQUES	FAMILLES	POIDS DU M³ DE GRUME A L'ETAT VERT/KG	DENSITE A 15 % D'HUMIDITE	TRAVAIL ET REMARQUES	UTILISATIONS	Strength Group	Joint Group	Durability	Lyctus sus.
68	EYOUM 219 (Mlang) 221 229	Dialium spp. 219 221 229	Césalpiniacées	900 à 1200	0,80 à 1,10	Bois silicieux. Très bonne durabilité naturelle, résistant aux termites et aux tarets	Tranchage : placage ébénisterie Sciage : traverses de chemin de fer, ponts.	S 3	J 2	1-2-3	S
69	CORDIA d'Afrique (Ebé) 173	Cordia Platythyrsa 173	Boraginacées	750	0,40 à 0,60	Bonne durabilité naturelle, surtout pour le bois coloré	Sciage : ameublement, ébénisterie, menuiserie légère.	S 7	J 4	2-3	S
70	GOMBE (Ekop-Gombé)	Didelotia africana 230	Césalpiniacées		0,60 à 0,70		Tranchage : placage ébénisterie Déroulage : contreplaqué Sciage : menuiserie, aménagements intérieurs.	S 2	J 2	3	S

TABLE 4

HARDWOOD STRUCTURAL GRADES

Permissible Imperfections	Ref	Structural No 1 75%	Structural No 2 60%	Structural No 3 48%	Structural No 4 38%
Knots(sound or unsound oval and arris) measurement not exceeding A of the width of the surface on which they occur (see Fig1)	A	one-seventh	one-quarter	one-third	three-eighths
Borer holes not associated with decay. Up to 3mm dia- not exceeding B in any 100m x 100mm or equivalent area.	B	12	20	Unlimited	Unlimited
Over 3mm diameter or where the distance between holes is less than twice their diameter as for knots.					
Tight gum veins - not exceeding C in aggregate	C	length of piece	Unlimited	Unlimited	Unlimited
No individual vein exceeding D of the length of the piece. Not extending from one surface of the piece to another.	D	one-half	-	-	-
Loose gum veins and shakes - not exceeding 3mm wide Aggregate length not exceeding E of the length of the piece. Not extending from one surface of the piece to another	E	one-tenth	one-ninth	one-quarter	one-third
Gum, latex or resin pockets and overgrowth of injury-					
Length- individually not exceeding three times the width of the surface on which it occurs or 300mm whichever is the lesser					
Width, if on one surface only, individually not exceeding F of the width of the surface or	F	one-quarter	one-third	one-half	one-half
G whichever is the lesser	G	12mm	20mm	25mm	30mm
If extending from one surface to another individually not exceeding H of the width of	H	one-eighth	one-quarter	one-third	one-third
the surface on which it occurs or J, whichever is the lesser, where it intersects an end it shall be considered as an end split (see below)	J	6mm	12mm	20mm	25mm

TABLE 4 (contd)

HARDWOOD STRUCTURAL GRADES

Permissible Imperfections	Ref	Structural No 1 75%	Strucutral No 2 60%	Structural No 3 48%	Strucutral No 4 38%
<u>Bow Spring and Twist</u> - Not exceeding the values given in Tables 7 and 8					
<u>Cupping</u> - not exceeding 1mm per 50mm of width.					
<u>Checks</u>. Surface checks-on surfaces up to 75mm wide-individually not exceeding K wide	K	2mm	Unlimited	Unlimited	Unlimited
- on surfaces exceeding 75mm wide, individually not exceeding L wide	L	3mm	Unlimited	Unlimited	Unlimited
Internal checks Projected length S (see Fig.1) not exceeding M of the thickness of the piece.	M	one-quarter	one-third	one-half	two-thirds
<u>Sloping grain</u> (see Fig.1) Not exceeding 1 in N	N	15	10	8	6
Primary rot and termite galleries		On the surface only and slight			Not greater than allowance for wane and want
<u>Wane want and sapwood susceptible to Lyctid attack</u>					
Not exceeding in aggregate or individually P of the cross sectional area	P	one-tenth	one-fifth	one-quarter	one-quarter
Not exceeding one-third of the thickness					
<u>Heart and heart shakes</u> Where the smaller dimension is less than 175mm - not permitted. Where the smaller dimension is 175 mm or more provided that they are in the middle third of the cross section of the piece					
<u>Included bark</u> - intersecting an end. Individual strands not more than Q long	Q	Not permitted	75mm	150mm	200mm
Not intersecting an end but within 600mm of an end, individual strands not exceeding R long	R	Not permitted	150mm	300mm	400mm

TABLE 4 (contd)

Permissible Imperfections	Ref	Structural No 1 75%	Structural No 2 60%	Structural No 3 48%	Structural No 4 38%
Included bark - Not intersecting an end and not within 600mm of an end but within the middle half of the depth - individual strands not exceeding S long and not less than 300mm apart.	S	15	300mm	600mm	800mm
Not intersecting an end and not within 600mm of an end but outside the middle half of of the depth - individual strands not exceeding T long and not less than 300mm apart.	T	300mm	600mm	Unlimited if tight	Unlimited if tight
End splits equal in aggregate to U times the face width or V, whichever is the lesser.	U	Not permitted	1	1.5	1.5
	V		100mm	150mm	150mm

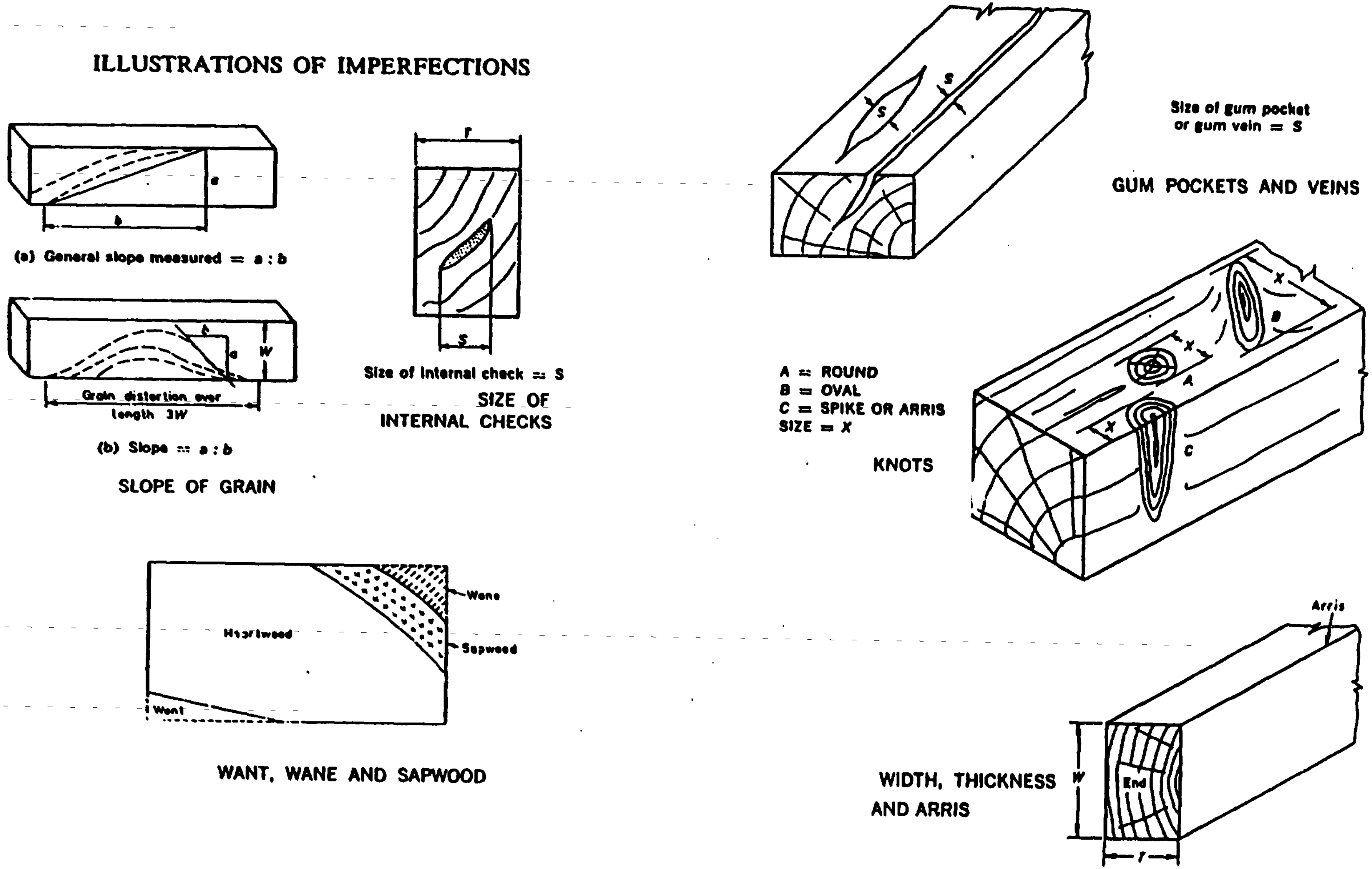
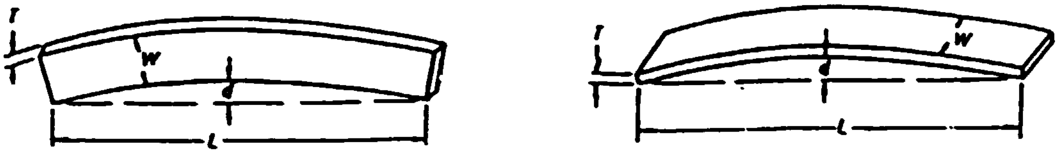


Fig. 1: Illustrations of imperfections



Spring = d (see Table 7 for values of d)

SPRING

Bow = d (see Table 7 for values of d)

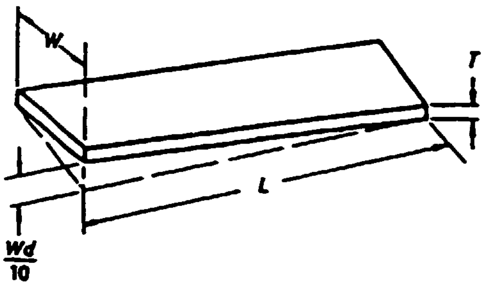
BOW

Fig 2 Spring and Bow

TABLE 7
MAXIMUM PERMISSIBLE SPRING OR BOW

Length L m	Maximum permissible spring or bow d, mm												
	Width W (for spring) or thickness T (for bow), mm												
	38	50	75	100	125	150	175	200	225	250	275	300	350
1.8	10	10	7	5	4	3	3	3	2	2	1	2	1
2.4	20	15	12	9	7	6	5	4	4	4	3	3	3
3.0	35	25	19	14	11	9	8	7	6	6	5	5	4
3.6	50	35	25	20	16	13	12	10	9	8	7	7	6
4.2	60	45	25	28	22	18	16	14	12	11	10	9	8
4.8	70	50	30	30	29	24	21	18	16	14	13	12	10
5.4	75	55	40	40	36	30	26	23	20	18	17	15	13
6.0	80	60	45	45	45	37	30	28	25	22	20	19	16
6.6	85	65	50	45	45	45	39	34	30	27	25	23	19
7.2	90	70	55	50	50	50	46	40	36	32	29	27	23
7.8	100	75	60	50	50	50	50	45	40	38	34	32	27
8.4	105	80	65	55	55	55	55	55	50	44	40	37	31
9.0	110	85	70	60	60	60	60	60	55	50	46	42	36

NOTE: The limitations on distortion have been governed by considerations of production and utilization within the constraints of the principles of structural adequacy as set down in Appendix G of AS 1720



Maximum permissible twist $= \frac{W \times d}{10}$ (see Table 8 for values of d)

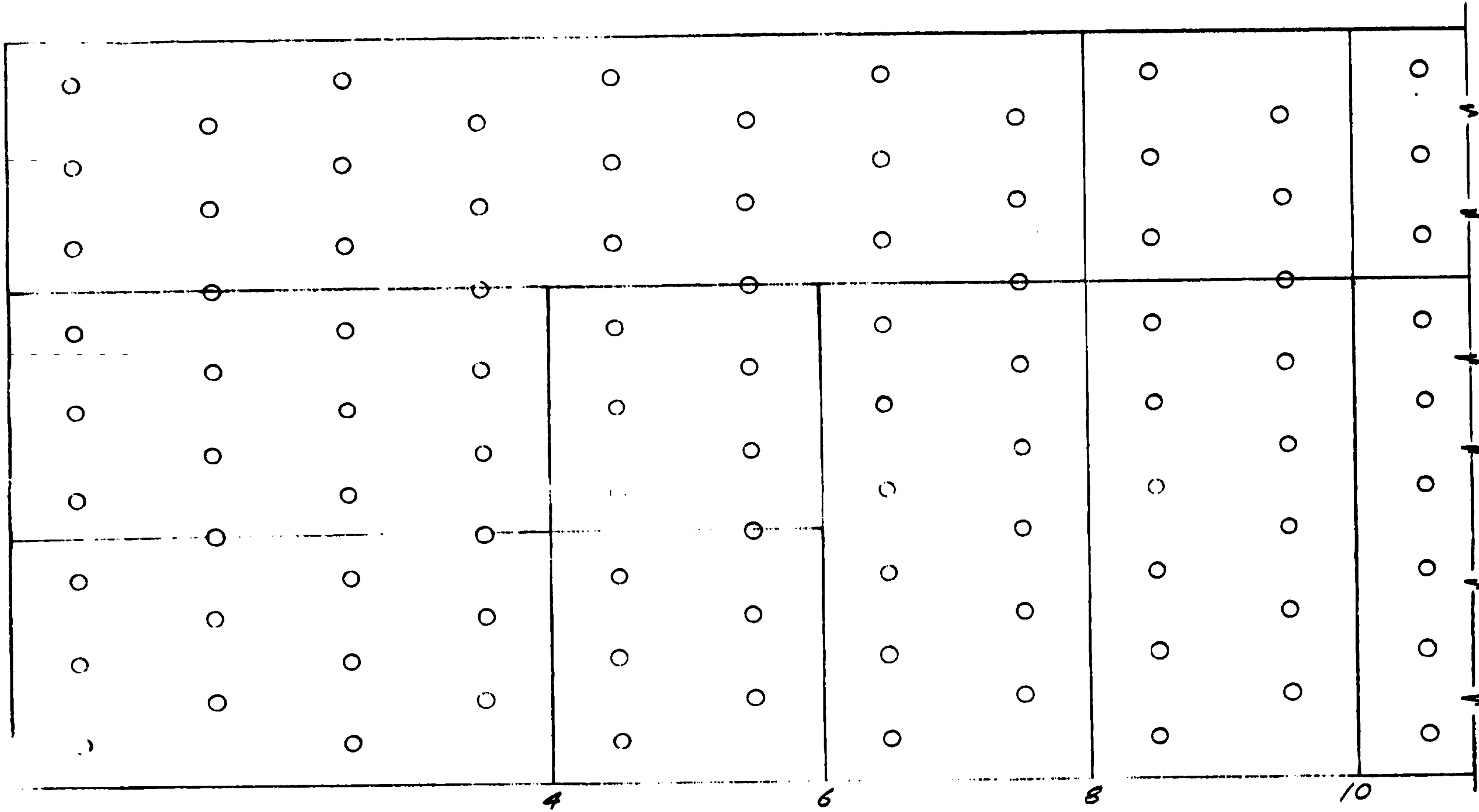
Fig. 3 TWIST

TABLE 8

MAXIMUM EQUIVALENT TWIST

Length *L*	Maximum equivalent twist, *d* mm/10 mm width of piece					
	Thickness *T*, mm					
m	38	50	75	100	125	150
1·8	1·6	1·2	0·8	0·6	0·5	0·4
2·4	2·1	1·6	1·1	0·8	0·6	0·5
3·0	2·6	2·0	1·3	1·0	0·8	0·7
3·6	3·1	2·4	1·6	1·2	1·0	0·8
4·2	3·6	2·8	1·8	1·4	1·1	0·9
4·8	4·2	3·2	2·1	1·6	1·3	1·1
5·4	4·7	3·6	2·4	1·8	1·4	1·2
6·0	5·3	4·0	2·7	2·0	1·6	1·3
6·6	5·8	4·4	2·9	2·2	1·8	1·5
7·2	6·3	4·8	3·2	2·4	1·9	1·6
7·8	6·8	5·2	3·5	2·6	2·1	1·7

NOTE: The limitations on distortion have been governed by considerations of production and utilization within the constraints of the principles of structural adequacy as set down in Appendix G of AS 1720.



PLAQUE A CLOUER

Fig. 5

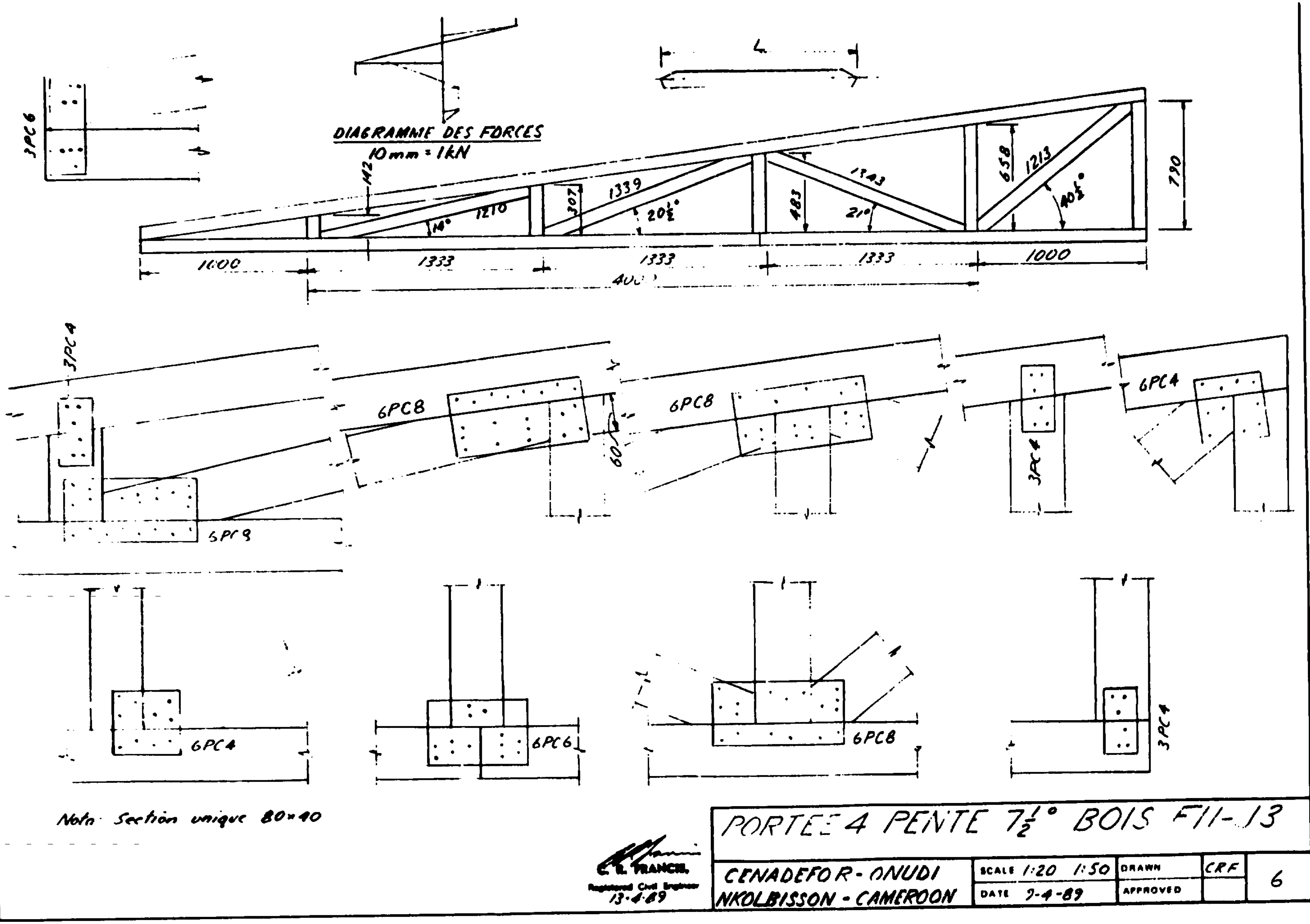
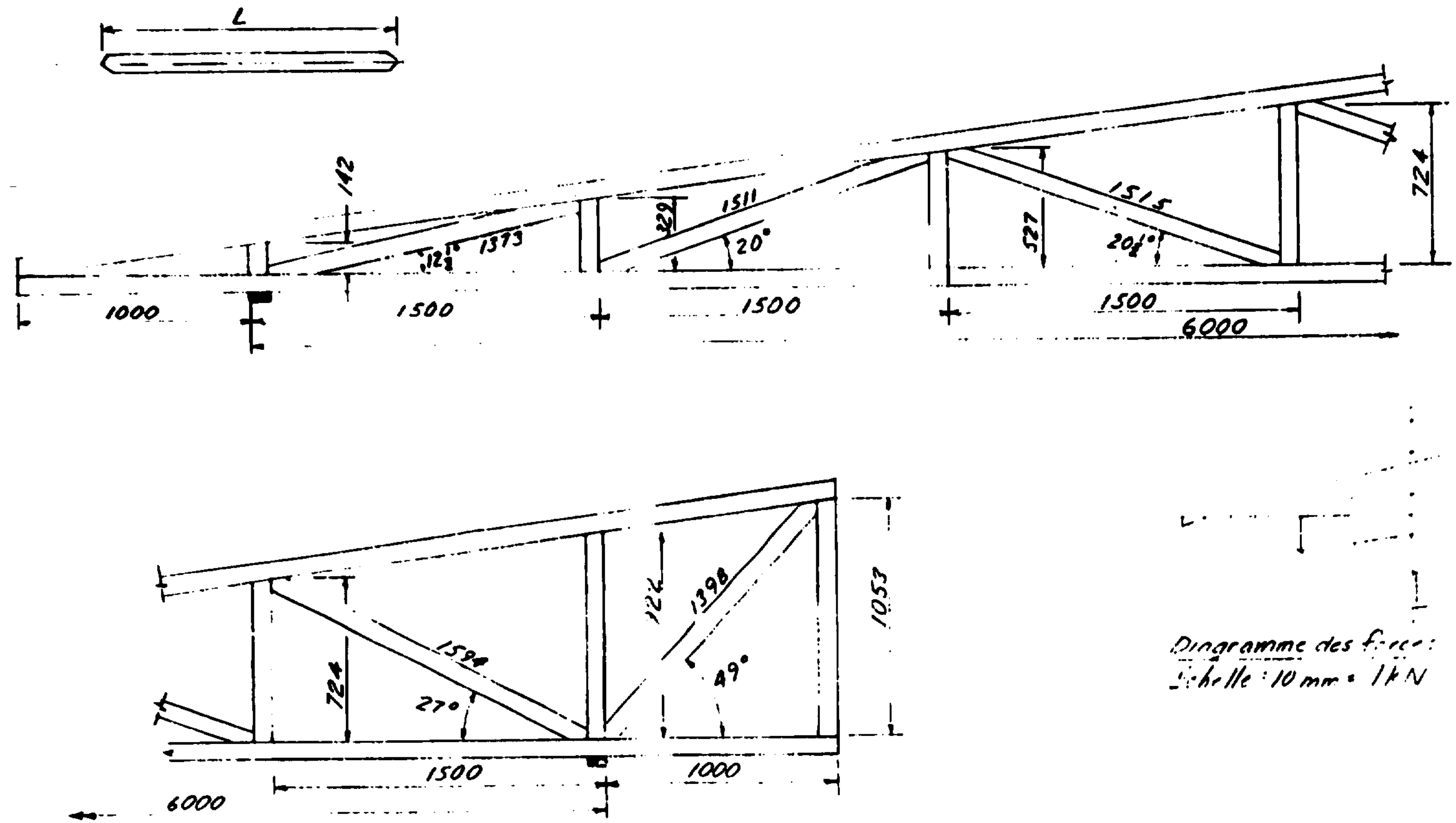


DIAGRAMME DES FORCES
10mm = 1kN
L
1213
40½°
1343
21°
1339
20½°
1210
14°
658
483
307
142
790
1000
1333
1333
1333
1000
4000
3PC6
3PC4
6PC8
6PC8
3PC4
6PC4
6PC9
6PC4
6PC6
6PC8
3PC4
60
Nota: Section unique 80×40
C. E. FRANCIS
Registered Civil Engineer
13-4-89
PORTEE 4 PENTE 7½° BOIS F11-13
CENADEFOR - ONUDI
NKOLBISSON - CAMEROON
SCALE 1:20 1:50
DATE 9-4-89
DRAWN CRF
APPROVED
6



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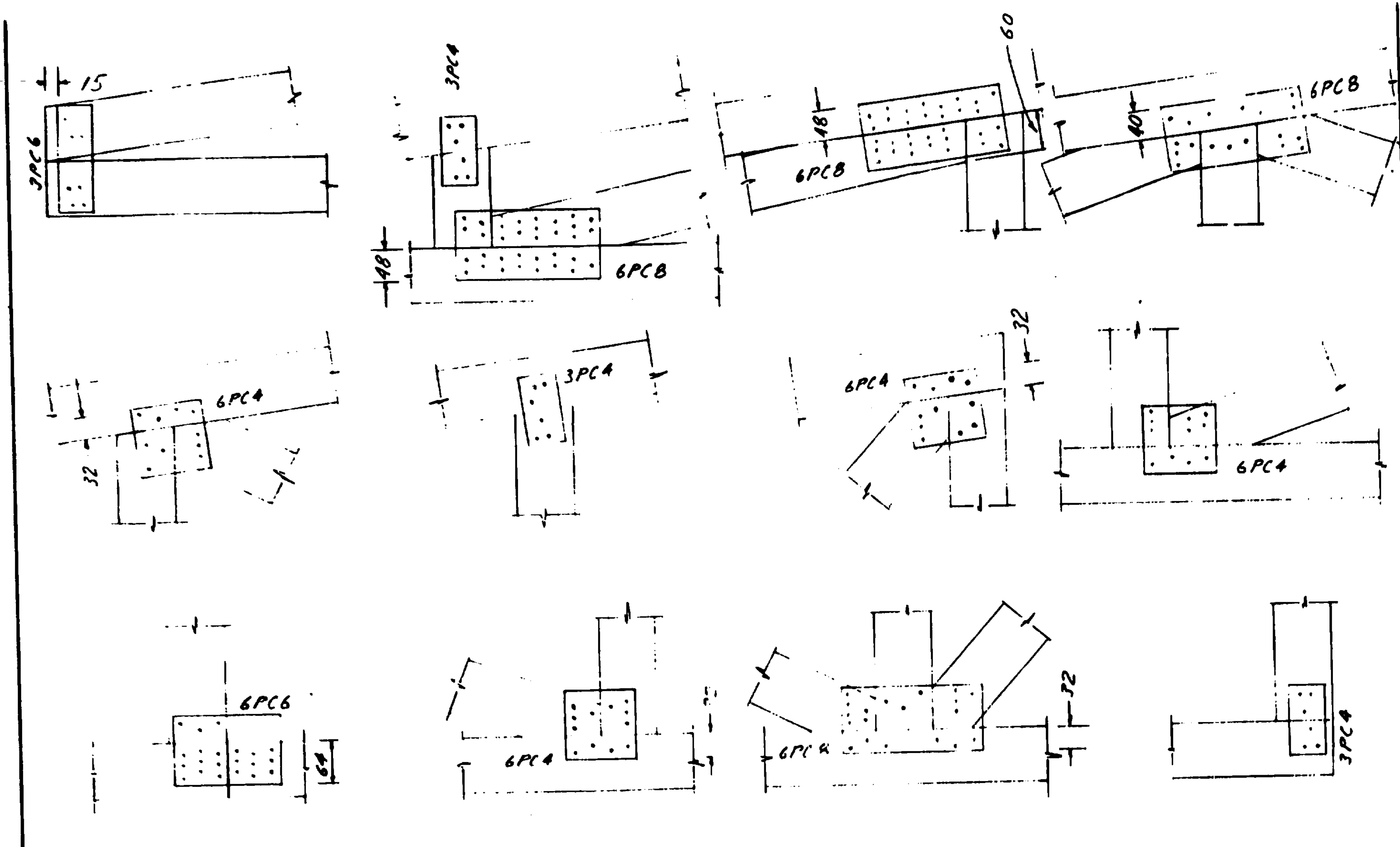
11-4-89

PORTEE 6 PENTE $7\frac{1}{2}°$ BOIS F11-J3				
CENADEFOR-ONUDI NKOL BISSON- CAMEROUN	SCALE 1:20	DRAWN	CRF	7
	DATE 10-4-89	APPROVED		



PORTEE 6 PENTE 7½° BOIS F11-1?

CENADEFOR - ONUDI
NKOL BISSON - CAMEROUN

SCALE 1:5	DRAWN	C.R.F.	7A
DATE 11-4-89	APPROVED		

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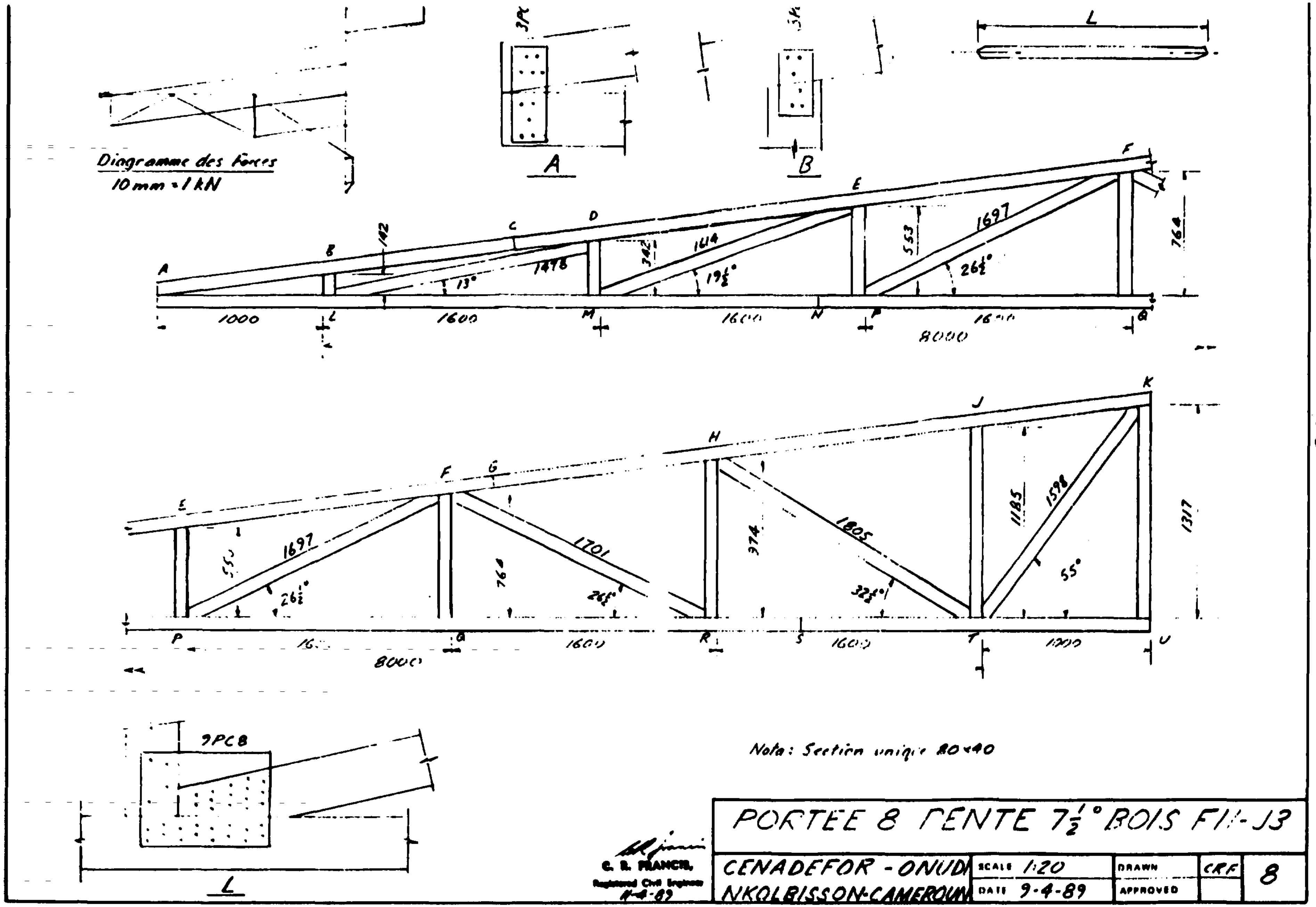

Diagramme des Forces
10 mm = 1 kN
A
B
L
A
B
C
D
E
F
L
M
N
P
Q
1000
1600
1600
1600
8000
182
342
553
764
13°
19½°
26½°
1478
1614
1697
E
F
G
H
J
K
P
Q
R
S
T
U
1600
1600
1600
1000
8000
550
764
374
1185
1317
1697
1701
1805
1598
26½°
26½°
32½°
55°
9PC8
L
Nota: Section unique 80×40
PORTEE 8 PENTE 7½° BOIS F11-J3
CENADEFOR - ONUDI
NKOLBISSON-CAMEROUN
SCALE 1:20
DATE 9-4-89
DRAWN
APPROVED
CRF
8
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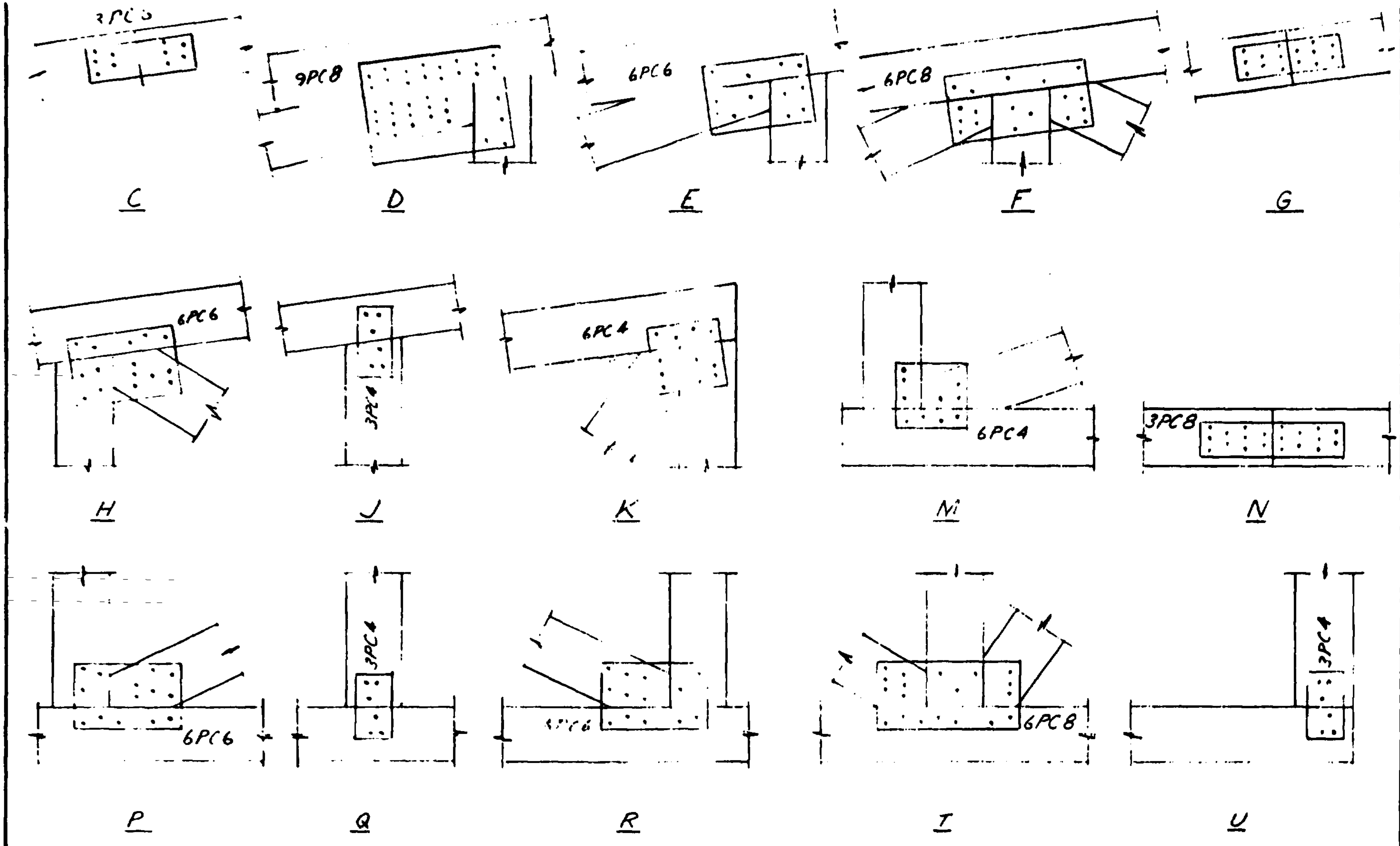
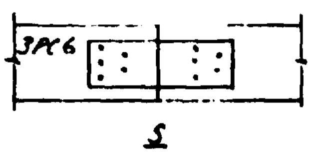
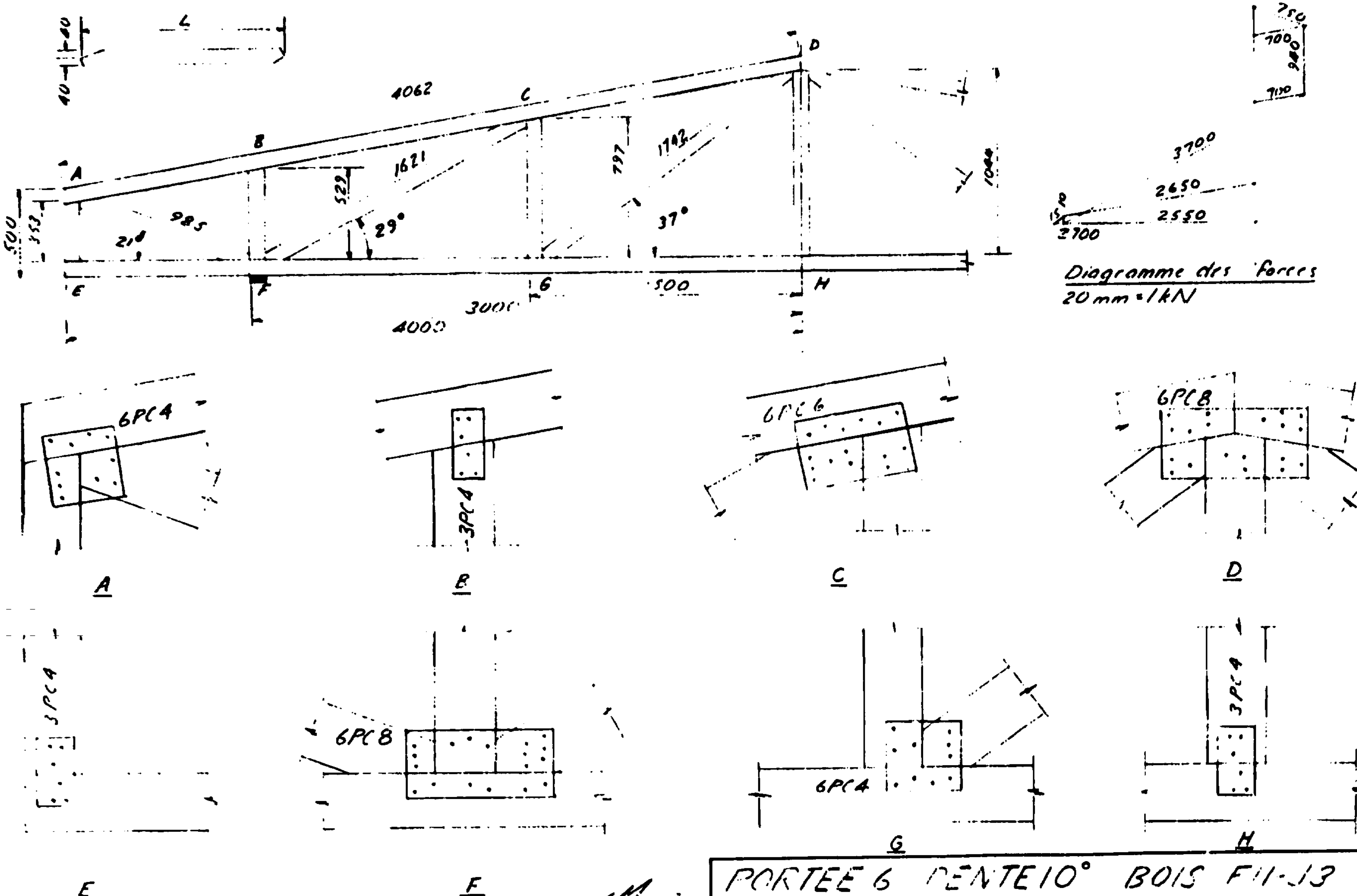
Registered Civil Engineer
11-4-89





C. R. FRANCIS,
Registered Civil Engineer
14-4-89

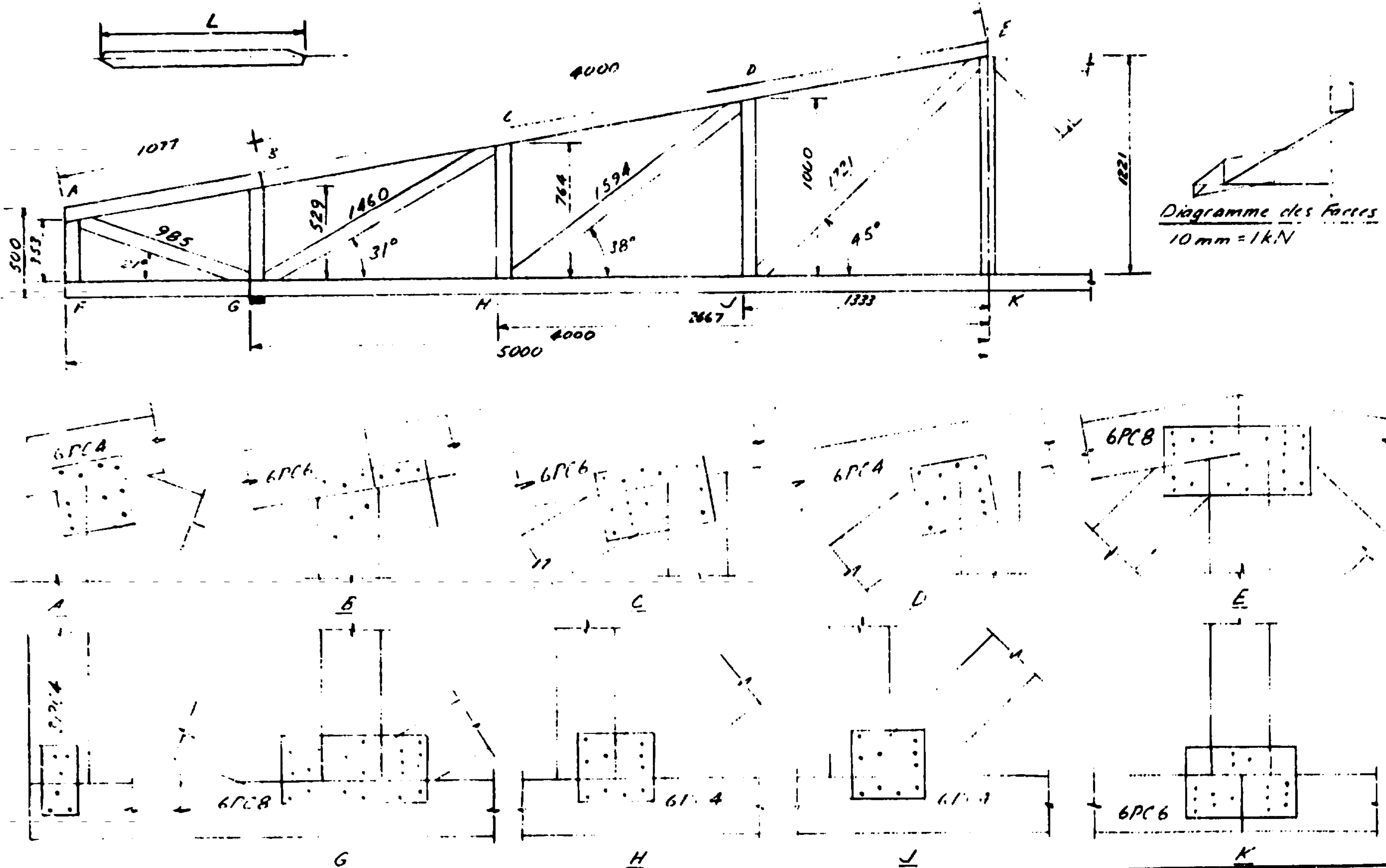
PORTEE 8 PENTE 7½° BOIS F11 - J3			
CENADEFOR - ONUDI	SCALE 1:5	DRAWN CRF	8A
NKOLBISSON - CAMEROUN	DATE 14-4-89	APPROVED	



Nota: Section unique 80×40

C. E. FRANCIS
Registered Civil Engineer
19-4-89

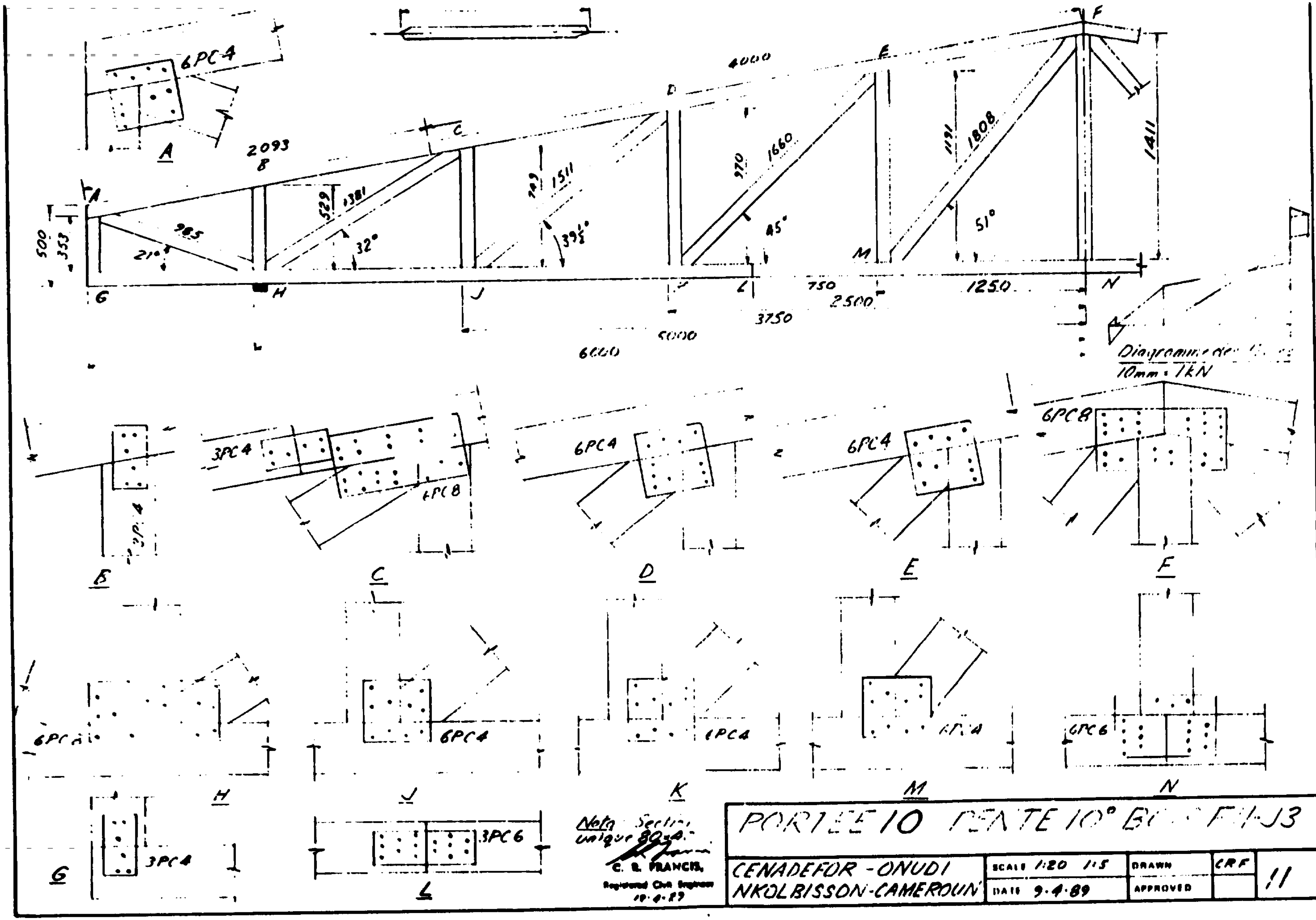
PORTEE 6 PENTE 10° BOIS F11-13			
CENADEFOR - ONUDI	SCALE 1:20 1:5	DRAWN CRF	9
NKOLBISSON-CAMEROUN	DATE 8-4-89	APPROVED	



Note: Section unique 80×40

C. R. FRANCIS
Registered Civil Engineer
8·4·89

PORTEE 8 PENTE 10° BOIS F11-J3			
CENADEFOR -ONUDI NKOLBISSON-CAMEROUN	SCALE 1:20, 1:5 DATE 8-4-89	DRAWN CRF APPROVED	10


6PC4
A
2093
B
C
D
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F
1411
1808
1191
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985
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21°
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J
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750
2500
1250
3750
5000
6000
Diagramme des ...
10mm = 1kN
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6PC8
6PC4
6PC8
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6PC4
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6PC6
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3PC4
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J
L
Nota Section unique 80x8.
C. R. FRANCIS
Registered Civil Engineer
19.4.89
PORTEE 10 PENTE 10°
CENADEFOR - ONUDI
NKOLBISSON - CAMEROUN
SCALE 1:20 1:5
DATE 9.4.89
DRAWN
APPROVED
CRF
11