INDUSTRIALIZATION CALLS FOR STANDARDIZATION

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Introduction

The subject of this contribution to the history of technical sciences is to illustrate how the development of industrialization and simultaneously the steady growing of the commercial relationships generate an increasing need to speak the same language. By the same language in the technics it is meant that the same concepts are handled in the translations, e.g. the same measures and weights are used. Therefore normalization work has to follow this increasing need and agreement upon specified features must be reached in order to set up general accepted standards.

The development of this theme is mainly restricted to the field of the textile technology. Three items are treated for which the standardization of measures has been the result of satisfying the need to univocal commerical transactions. Each one of these examples concerns measures used for the description or qualification of textile products. It is obvious that the acceptance of standard measures has favoured commercial relations or will do it in the future.

The items developed below are historically spread over a long period. Without knowing precisely the time limits, when they occured, the first example is taken from the very distant past, the second item concerns an almost actual problem, although the final general consensus has not been reached yet and the third item may be a protection of development in the not so distant future.

Taking these three items in consideration it becomes clear that the growing communication facilities in the large sense of the term, promotes the commercial relations and also the industrialization, which in turn calls for progressive standardization. Reversely the

increasing package of standards must favourably affect the technological evolution.

Parallel to this development it will also be clear that the so called standardization in the past, finds its application in rather restricted communities such as gildes, corporations or cities. Then, due to the growing industrialization, the field of application expanded within sections or subsections of the textile industry, but already outside the powerful city towns. The field of application becomes regions, which for certain items are transgressing the borderlines of nations, but remains almost within countries having the same communication language. It has to be expected that in a not so distant future standardization work has to be performed at a universal scale as it is already done in the different ISO-bodies. However it is to be feared that by the extreme slowness of reaching an international concensus the industry will take the lead. This is in itself not to be disapproved, when the industry would reach within their federations a general or large consensus. The latter is not a wishful dream, but a necessity of vital importance for each industrial activity and thus for the textile industry which in Flanders has been of old a prosperous industrial activity and still remains so.

The "ell" as length measure for textiles

This first item concerns a length measurement which has been used in the past mainly in textile communities.

It is obvious that in the pre-industrial ages by the lack of precise instruments the measurements of parts of the human body are used to express lengths, widths and thicknesses or heigths and depths with a figure. So the well known "fathom" may originally be defined as the distance between the finger tips by a horizontal stretched arm position. In England the half fathom becomes more in use and is called "yard". In addition the fathom measures such as foot, palm, and inch are also in use. The recognition of the extreme variability from man to man of the mentioned body parts, generates the need for standard measures such as rules. But these standard rules were different from quarter to quarter, from city to city and from region to region.

The following development was to find out a coherent measure system. So, for instance, for one of these systems it was agreed that 4 inches would be equal to one palm, three palms or 12 inches equal to one foot, three feet or 36 inches equal to one yard, and finally 2 yards or 72 inches equal to one fathom. It falls outside the objectives of this contribution to describe also the variability of each one of these measures. As already mentioned the length measure which is more specific for the measurements of textile products will be treated here. Such a measure, not yet mentioned, is the "ell" and this kind of measure was already in common use in the ancient civilisations in Babylon and Egypt practically exclusively for flexible materials such as fabrics, ribbons, cords and laces.

In the archives of the city of Ghent one may read that from 1760 to 1791, due to the success of the factory of Joos Clemens in Ghent and of all the printing works of the Southern Netherlands, the import of cotton sheets increased from 175.000 to circa 4.160.000 ell. How long this ell should be taken is not mentioned, but probably it concerns the ell used by the city of Ghent. For sure in the beginning people have used as many different ell measures as there were different merchants and dealers. In order to avoid fraud or disputes this situation was to be settled and this was done by regulations edicted by the local authorities or conventions within gildes, where a physical ell-standard was kept. Such a standard ell was then considered as the recognised length measure to be used by the gilde members or by the citizen of the city for the measuring of textile products.

In order to give an idea of the variability of the so called ell-standards a graph has been dressed. The data are taken from the "Dictionnaire Universel des Poids et Mesures" written by DOURSTHER. The graph represents the histogram of the ell-standards for about 550 cities spread allover the European continent. Fig. Higher peaks in this histogram are related to e.g. the "ell of Paris", which has been recognised and used by the majority of French towns and a number of towns in the Valais of Switzerland. An other peak is shown by the "ell of Brabant", which is applied by most Flemish cities. Shorter ells are used in German towns and in the german speaking part of Switzerland. Flemish towns who did not follow the ell of Brabant are given in a separate table.

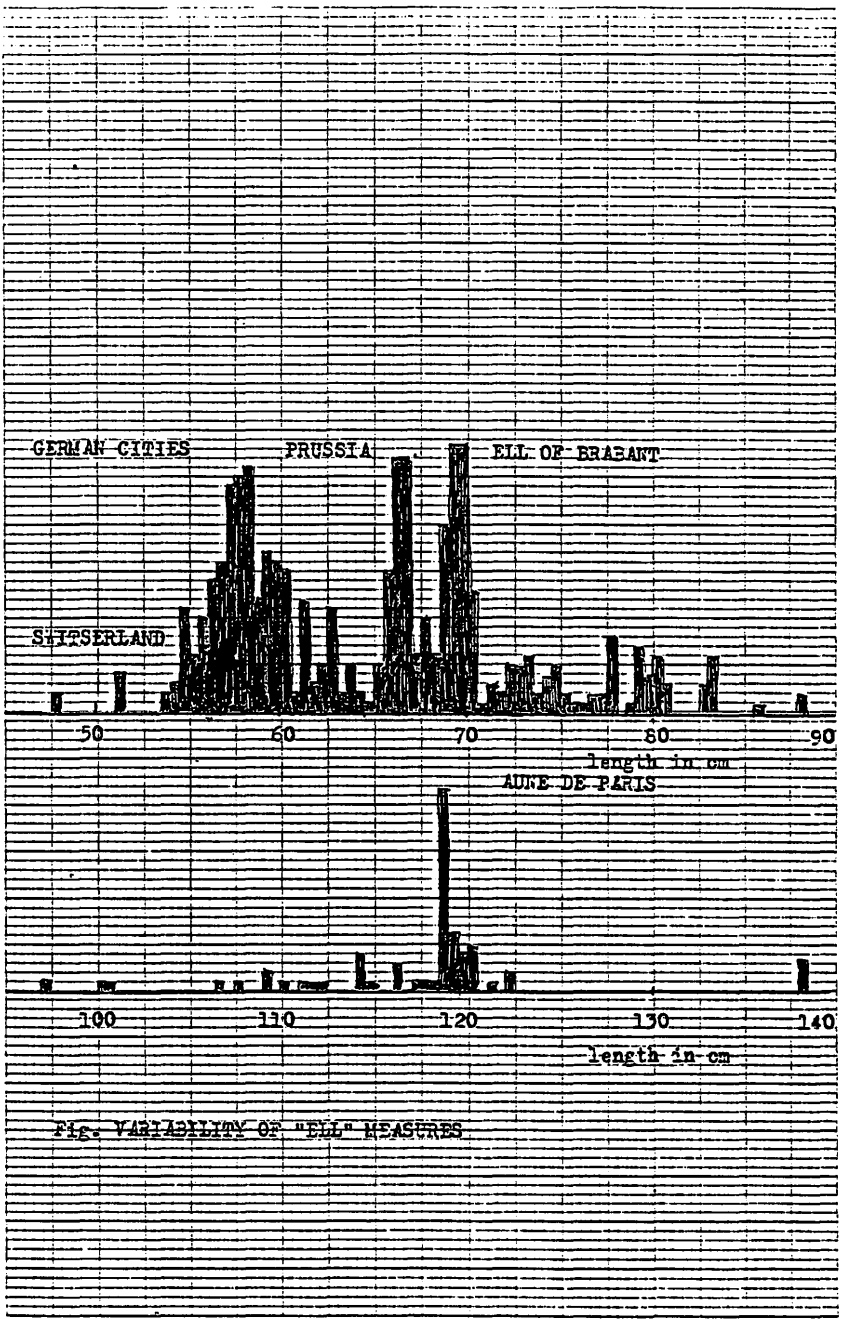

Fig. VARIABILITY OF "ELL" MEASURES

Table 1 — ELL MEASURES USED IN FLEMISCH CITIES

City	Subject of application	Length in cm
Aalst	Large ell	71,9 cm
	Retail trade	63,9
Antwerp	Ell of Brabant *	69,5
Dendermonde	Whole sale trade	73,1
	Retail trade	69,6
Ghent	Ecru cloth	76,5
	Bleached cloth	72,8
	Retail trade	69,8
Herenthals		68,6
Ypres		69,7
Courtrai	Ecru cloth	73,7
	Bleached cloth	69,1
	Retail trade	71,0
Louvain		68,0
Lier and Malines		68,9
Menen	Lace	71,3
	Table cloth	69,3
Oudenaarde	Ecru cloth	76,8
	Whole sale trade	73,4
	Retail trade	70,3

* in application by most of the Flemish Cities

In this table one can observe that the city of Ghent has standardised three different ell lengths. The longer one is used on the "Freiday market" in order to measure linnen offered to sell by the farmers in lengths of 40 ells. The longer ell was also used in the so called "cloth measuring houses" where the length of the pieces of cloth are mesured or controlled by officials.

The shorter ell is used for the measuring of milled cloth in the wet state. Both ell standards are kept by the governing body of the city of Ghent from 1546 until 1786.

In 1790 a decree of the constitution in France charged the Academy of Science to set up a coherent, unique and decimal unit system in order to replace the multiple existent measuring systems. At that time the ell was subdivided in 16 talies and was therefore not decimal. After having measured the distance between Dunckerque and Barcelona and estimated the 10,000th part of the total length of the meridian the Academy of Science has defined this part as being the new unit called "meter". By a decree of 2 November 1801 the meter becomes a universal and legal unit for measuring the length. Shortly thereafter the metric system, which was decimal, was built up and the use of that system obligatory since 1 January 1840. In the Netherlands the new meter unit was adopted in 1816 under the name of the "ell of the Netherlands". In Belgium the new unit has been introduced since 18 June 1836.

The meter standard in platina is kept at 0° C in the "Pavillon de Breteuil" in Sèvres. Later on the same standard has been redefined, taking as a base the wave length of the specific red line in the spectrum of cadmium or, such as it has been done by the National Bureau of Standards, on the base of the wave length of the specific green line of the spectrum of the mercury isotope 198.

Only the Anglo-saxon countries have pursued the use of yards, feet and inches. This fact is not without significance for our countries, because there are close relations between England and the low countries by the sea of the continent.

In the fourteenth century Flemish weavers settled in England and gave to the existing textile activities a marked impulse. At that time England made a kind of an industrial revolution by the increasing growth of cloth preparation technics and the application of water-power for milling operations.

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The export of English cloth to Brabant and Flanders has made an end to the traditional textile industry in these countries. By this situation the Flemish weavers imported Spanish wool and wove new lighter and cheaper cloths, which they exported in turn to England. This alternation of success and crisis situation in England and in the low countries by the sea repeats itself during centuries. Remember the industrialist *Lieven Bauwens*, who set up in 1800 cotton spinning mills in Flanders. This made it possible to produce cotton fabrics, called calicaot's, which is a degenerated form of Calcutta, the city in India from where these fabrics originally were imported. These historical facts explain why a prolonged use of english measure systems could be observed in our textile mills. For sure the "ell" is not used anymore as a measuring unit. Some idiomatic expressions are still remainings of the past situation.

The count as a measure for the fineness of textile strands

By the growing complexity of the industrial and commercial activities the need for normalizing systems in general and specific systems for the textile industry in particular. Such a need has broken through in the textile industry, where the use of synthetic fibres and the growing importance of products composed with fibre mixes, has been the stimulating factor in setting up a logic system for the designation of the fineness of products as fibres, single and plied yarns and filaments.

In the textile industry a large number of systems have been in use for expressing the fineness of these products, depending as well upon the material used as upon the region and industrial sector taken into consideration. Direct or weight numbering and indirect or length numbering have been in use. In the length number system the count expresses the amount of length units which are in a specified weight unit. The units which are involved differ markedly from one material to the other. This differentiation may be explained by technological reasons, since the common presentation of the material under the form of leas is different for each kind of material and for each different textile community.

Table 2 — INDIRECT COUNT SYSTEMS

Name	Symbol	Length unit	Mass unit	Application
Metric count	Nm	1000 m	1000 g	General except silk and filament
French count	Nf	1000 m	500 g	Cotton
English count	Nec	840 yard	1 lbs	Cotton, silk waste
English linnen	Nel	300 "	1 "	Wet spun flax
English wool	New	360 "	1 "	Combed wool
English wool	New	256 "	1 "	Woollen yarn
Typp	Nt	1000 "	1 lbs	"
Allooi	Na	11520 "	1 lbs	"
Galashielt	Ng	200 "	1 lbs	"
Hawick	Nh	320 "	1 lbs	"
American wool	NaW	1600 "	1 lbs	"
Dewsbury	Nd	16 "	1 lbs	"
American asbest	NaA	100 "	1 lbs	Asbestos and glas
British asbest	NbA	50 "	1 lbs	Asbestos
Catalonia	NcC	500 canas	1 lbs	Cotton
Espania	Np	1320 meter	1 lbs	
Irish wool	NiW	64 yard	1 lbs	Woollen yarn
Cardado coreil.	NpW	1 meter	5 gram	Woollen yarn

Table 3 — DIRECT COUNTS SYSTEMS

Name	Symbol	Mass unit	Length unit	Application
Legal denier	Td	50 mg	450 m	Silk and Synthetics
		1 g	9000 m	
Scottish	Ts	1 lbs	14400 yard	ry spun flax, jute
Aberdeen	Ta	1 lbs	14400 yard	Woollen yarn
Poumar	Tp	1 lbs	1000000 yard	
Silk	Tsi	1 dram	1000 yard	Silk
American count	TaG	1 grain	20 yard	Woollen yarn
Spanish	To	1/4 ounce	500 canvas	"
Catalonia	TcW	1 g	504 m	"
Grex	Tg	1 g	10000 m	
TEX	Tt	1 g	1000 m	UNIVERSAL

A typical example is the expression of the fineness of textile materials composed from silk in "denier" units. This unit was originally used for the measurement of the fineness of silk, later on also in use for manmade fibres or filaments. The term itself is deduced from "denarius", which is an old roman coin and has the value of ten "as". The same term was used by the romans as a weight equal to the 84th part of a pound. In France the "denier" is also known either as an old french coin equal to the twelfth part of a "sou" or as a weight, known as a "dernier tournois", which is equal to 45 mg. Furthermore the term "denier" is also, such as carat for gold, an expression for the parts of silver 12 being pure silver. In the textile world the term "denier is used to express the weight of silk. Until 1850 in Lyon, the centre of the silk industry, the weight count of silk filaments was based upon leas of 475 m and expressed in Montpellier grains weighing 45 mg. The length of 475 m represents the average workable length of silk filaments, which could been withdrawn from a cocoon. The Conference of Paris reduced this length in 1900 to 450 m and rounded the basic weight unit to 50 mg. By reeling off 20 cocoons at the time, which is a current procedure, the definition of a denier may formulated as being the weight of 9000 m, expressed in gram.

So far the origin of "denier" used for expressing in the past the fineness of silk filaments. Analogue explanations may be given for the other count and numbering systems, but this falls outside the aim of this paper.

It is clear that such a variability in expressing the fineness of textile strands may not be beneficial to the industry and to commercial transactions. Not so long ago lessons given in technical schools spent more than one semester in explaining the different count systems and in resolving problems of converting one count into one from an other system.

The fineness unit expressed as the mass per unit length and more particularly the expression in gram per kilometer has already been suggested in 1873 during a Conference in Vienna. The tex system, such as it is called nowadays, was not really a new idea when in 1956 in Southport at an ISO-meeting of technical Commit-

tee 38 unanimously the adoption of that count system was recommended. A committee adhoc, which met in 1957 in the Hague, was charged to activate the use of that universal count system by National and International Textile Federations and Associations. It may be said that especially commercial bodies, presumably by love of ease, did not accept this recommendation with enthusiasm and even today some merchants and dealers keep aloof from the recommended tex system. In technical sciences the use of the tex system is unquestionably a tremendous simplification. The system is not only a metric system, such as the metric count system, but is at the same time a decimal system, so that multiples and fractions may be used and designated by the prefixes "kilo" "deci" and "millitex". Such a facility does not exist with the metric count system. It is sometimes discouraging to state that actually, 30 years after the decision taken in Southport, locally still out of date or archaic count systems are in use.

The introduction of the tex system on the side and the legalisation of the International and coherent Unit system on the other side, has next to the fineness expression also interfered with other textile expressions commonly in use. So the designation of yarns, the lea and single thread strength the twist factor and cover factor to be revised. As an example one of these revisions is given below.

The breaking length as a measure for the yarn strength

It is common practice in the textile industry of the continent to express the strength of yarn by the breaking length, which may be defined as the length of yarn having a mass of which the earth attraction power is equal to the average tensile force. As long as the fineness is defined as a weight per unit length it was sufficient to divide the tensile strength by the count to obtain a length dimension. The length, so obtained, is commonly expressed in kilometer. By the introduction of the coherent international system of units in which the kilogram force has to be banned, and by the definition of the count in tex, being a mass per unit length, an expression of the specific tensile strength is obtained by dividing the tensile force in Newton by the fineness in tex. The numerical value of this specific strength, expressed in centiNewton per tex has to be divided by the

factor 0, in order to obtain the commonly used breaking length in kilometer.

So far the problem of expressing the fineness by counts and the inference upon other expressions used in textiles.

Classification systems of carpeting

By this we have reached the third item of this paper, a theme which is more a projection for the future. It concerns the classification of carpets and the way of classifying a carpet in the system. It is surely not a surprise to state that also in this field a variation of classification systems are already in use. The application of these systems is not so strongly depending upon the used textile materials as it was in the past by the count systems. The classification systems already in use are transgressing the border lines of nations and cover larger fields in the European community. The german classification system is largely adopted by Germany Austria and German Switserland. The Scandinavian system is largely applied in Sweden, Norway, Finland and Denmark. The ICCO-system is adopted in France, Belgium and for some time ago also in Great Brittain. Another classification system found its application in national and European Institutes Housing. Finally there is also an international IWS-system which has an international application but reserved only for wool carpetings.

Taken into account that Belgium is the largest producer of carpets in Europe and therefore also the largest exporter it becomes of prime importance for the producer and for the commercial transactions to reach a universal recognised carpet classification system. Therefore is it interesting to describe very shortly the essentials of the ICCO-classification system and to show how it is established.

In the first place in compliance with Iso-recommendations a kind of interrelation is adopted between the rooms on the one side and the wear conditions on the other side. This interrelation has been set up as well for domestic use as for public use of the carpet. Are excluded from this classification system the luxurous carpets and the carpets for decoration.

Tabel 4 — REVIEW OF THE IMPORTANT SPECIFICATIONS IN THE ICCO-CLASSIFICATION SYSTEM

Class	Change of Appearance	Static Compression	Minimum requirements for all classes
T2	1	2,0 mm	Fastness to light pale shades 3-4 middle " 4-5 dark " 5-6 Fastness to rubbing 4
T3	2	1,5 mm	
T4	3	1,0 mm	Castor chair test 5 kilocycles 3 25 " 1
T5	3 - 4	0,8 mm	5 kilocycles 3 25 " 1

The classes for domestic use are partly overlapping the classes for industrial use so that in total maximum four classes are taken into consideration. These classes are numbered from 2 to 5.

Next to this subdivision in classes minimum requirements are specified valid for all classes. These requirements are given in table.

Furthermore reference tables are established for carpets with pile composed of wool, acrylic, texturised or spun polyamide, spun polypropylene and for a number of commonly used mixes of acrylic and polyamide or wool and polyamide.

In addition to these minimum resuirements valid for all carpets and restricted to descriptive characteristics of carpets, there are also requirements in the field of the wear conditions of the carpet. The durability of a carpet is assessed by a drum test where after a treatement during 22,000 cycles by a heavy rolling hammer the change of appearance is determined. This change may not be less than the limits given in Table 4.

For the evaluation of the change of appearance the ISO subcommittee in charge established different types of reference scales each of which is composed by physical carpet samples and represents five stages of heaviness of attrition numbered from 1 to 5. These reference scales are pretended to be useful in assessing the durability after all different kinds of use conditions.

Finally a last specific characteristic of a carpet is the compression under seat or table legs. A special instrumentation measures the remanent compression after a recuperation time of 60 minutes. The maximum compression in function of the classification steps are given in table 4.

Carpets for classification step T-4 and T-5 have to be tested supplementary by the castor chair test.

Sofar the ICCO system for the classification of pile carpets.

Conclusion

So far three themes taken from the textile world in order to sustain the thesis that the development of the commercial transactions and parallel to this development the progress of the technologic evolution, if not revolution, and the increasing industrialization has generated the need to use standard measuring systems and to use these systems for the creation of universal accepted classification systems for commercial products. At the same time we have shown that in the old ages these standards are recognised in very restricted communities such as gildes, cities or local markets. With the time

and the further development of industrial communities some of these standards are spread within a particular industrial activity such as the linnen, wool, cotton or silk industry. The use of man made fibres and mixes has created the need to accept one and the same fineness standard for all textile products.

Finally it is to predict that by the creation of the new open market in the European countries new needs will rize for standardization such as it will be the case for the international classification of carpets. It is hoped that such a classification system will be realised in a not so distant future.

This is really what is meant by the title "Industrialization calls for standardization".

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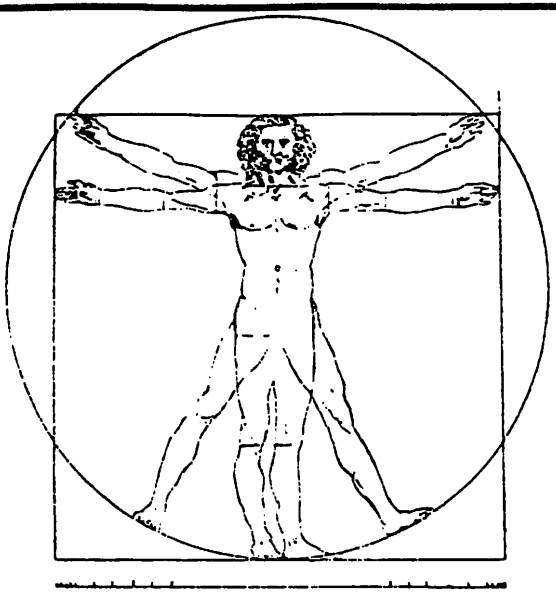

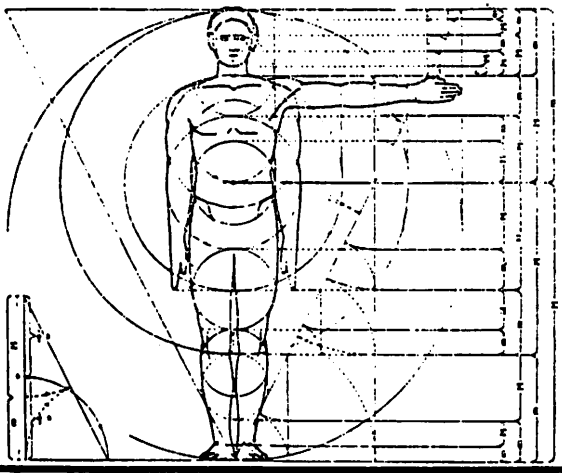

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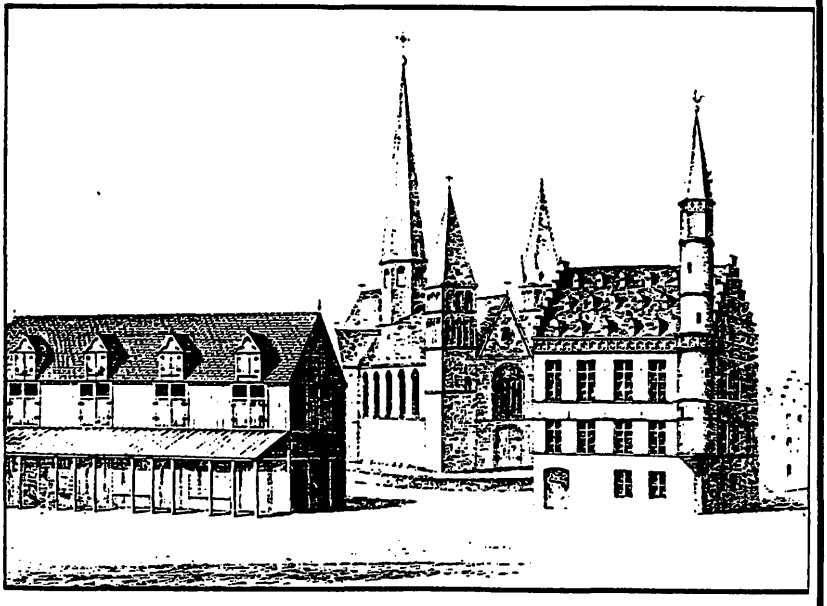

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COCON AFWIKKELEN

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KLASSERING DER LOKALEN EN DER GEBRUIKSVOORWAARDEN

KLASSE	HUISHOUDELIJK GEBRUIK	PROFESSIONEEL GEBRUIK
	Licht gebruik bv. slaapkamers	
	Normaal gebruik bv. woonkamer	Matig gebruik bv. Privé-kantoor
	Zwaar gebruik bv. alle woonkamers	Normaal gebruik bv. vergaderzalen
	Intensief gebruik	Zwaar gebruik bv. openbare plaatsen winkels en dergelije
	Decoratieve of luxe-tapijten