MANUAL

OF

Reenforced Concrete Construction

BY

EDMOND G. F. R—. DU MAZUEL, B.L., D.Sc., L.Sc.

Formerly Constructing Engineer, Roads of Isere Section, France; Chief of Staff, Military Improvements of the Harbor of Algiers, Algeria; Non-Resident Lecturer, Ecole Polytechnique. Consulting Engineer, New York City, in charge during construction, of important works in America such as American Asbestos Mills, at Black Lake, Canada; Power Stations for Iroquois Construction Co., at Niagara Falls; Power Stations and Transmission Lines for Niagara, Lockport & Ontario Power Co., etc., etc.

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MANUFACTURERS OF THE DU MAZUEL REENFORCEMENTS FOR CONCRETE

PREFACE

Concrete is rapidly replacing other materials for building purposes.

This publication as a whole, more thoroughly than any previous one of its kind, sets forth briefly the principles and methods of concrete architecture.

Reenforced concrete construction is a comparatively new subject in America. An engineer, architect or builder, therefore, need not as yet feel ashamed of lacking a working knowledge of this method of building, which is so fast superceding other forms.

The Manual is intended to be of practical assistance to engineers, architects and builders in designing and constructing reenforced concrete. Its purpose is to give facts, not theories, and be so clear and concise that even a person unaccustomed to building may understand.

It should not be lost sight of that there must be in any kind of construction, constant and competent inspection of the work. In reenforced concrete work this inspection is not so essential as in non-reenforced concrete, but it is still necessary.

CONCRETE
PLAIN AND REENFORCED

Going over the various materials that are known to have been used from almost the time when men abandoned caves and took to building their homes in the open, it is interesting to find that concrete, in a rough state, was the material used even before taking to log, frame, stone, and brick buildings. The value of concrete as a substitute for timber, stone, brick and iron foundations and superstructures is now well known, and the situation will be found exceedingly rare where this substance cannot be successfully employed, because it becomes petrified and thereby a one-stone structure. The pyramids of Egypt, particularly, are old and well known, and may be cited as an example of excellent concrete work, and as having been fairly tried by the test of time. Pieces of the giant blocks which have occasionally been taken by scientists, and by the writer himself, have by test shown themselves to be not inferior in hardness to some of the serpentine rocks of North America. A number of these tested pieces from the pyramids contained nummulites, which fossil shells were the petrified remains of the lentils which had been used as food by the workmen employed in the construction of these vast edifices and which had been thrown into the concrete mixers in accordance with the rites of their religion.

Naturally, the kind of cement used is of vital importance and is a matter that should always be considered with great care. It is to be regretted that some of the old and valuable formulae for cement used by the Mongolians, Egyptians and Romans were destroyed in the great fires of Alexandria and other old cities. However, science is giving us from day to day a better and better cement.

Where, in the course of time, iron and steel will rust and weaken materially, timber rot, and bricks flake and pulverize, concrete, when properly made, will stand for ages, being practically stone — for after all, stone is concrete petrified by nature.

It has been found that a very great degree of added strength can be secured by embedding iron or steel of various shapes in concrete. Two very great advantages of thus reenforcing concrete are: firstly, that the weight and size of a given structural member need be much less when reenforced than when plain; and, secondly, member for member, greater uniformity of strength is secured, making a safer and more reliable construction.

There are now in the market scores of different forms of reenforcement, such as bars — twisted, lugged, dented, etc.; steel sheets — bent, twisted, expanded, etc.; and wire cloth criss-crossed in every conceivable fashion. The author, in his professional practice as a general consulting engineer, found that every known form of reenforcement had grave disadvantages, the main ones being that their shape prevented their giving the distribution of strength where it belonged; that they required the use of expensive preliminary forms, the same as in plain concrete, the forms being of little or no value after once having been used, and that for a given degree of strength they required too much dead weight of materials.

To get a reenforcement that overcame the disadvantages just enumerated, the author, after much investigation, designed two kinds of reenforcements; one, the du Mazuel plain reenforcement made from flat bessemer or open hearth process steel into the peculiar reversed and double "S" form which brings the steel area where it belongs as a reenforcement, and the other the du Mazuel expanded reenforcement, made from any of the several kinds of expanded metal on the market, corrugated in such manner as to give it the greatest strength with the least amount of material.

CONCRETE MIXTURES

In any concrete structure, no matter how reenforced, the efficiency of the finished work depends largely on the selection of the materials, the proportions in which they are used and the care with which the work is executed.

Long experience has shown that best results have been had with mixtures of one cement to three or four of crushed stone; the crushed stone to be sound and to pass one-quarter inch mesh. These mixtures in thin floors and roofs have been found by actual tests to give the most satisfactory results with du Mazuel reenforcements, a one to three stone concrete having been used in arriving at the data of the diagrams or curves given herein. Where good crushed stone (trap rock or granite) is not available, a well graded sand or gravel will answer the purpose very well.

If in the judgment of the engineer, architect or designer a less rich grade of concrete is preferable, it must be remembered that the stone (or cinders if so desired) in the concrete filling the corrugations, must be of such size as to readily enter the contracted area between the corrugations, as otherwise voids would occur which would be detrimental to the strength of the structure.

Within recent years the writer has successfully used a waste product as a substitute for sand and stone, namely, iron ore tailings. It has been found as a rule to be a well graded material that produced a very satisfactory mortar or concrete.

When it is desired to color the concrete so as to produce certain effects, this may be done by thoroughly mixing with the cement, before adding the sand or stone, pulverized iron oxide of the basic color wanted and proportioning to the blend or tint required.

Tables of concrete mixtures and proportions, given herein, will be found to be of assistance in actual office and field practice.

PROPORTIONS FOR ONE CU. YD. OF CONCRETE								
MIXTURES			STONE 2½" SCREENED			GRAVEL ¾" AND UNDER		
Cement	Sand	Stone	Cement Bbls.	Sand Cu. Yds.	Stone Cu. Yds.	Cement Bbls.	Sand Cu. Yds.	Stone Cu. Yds.
1	2	3	1.75	.52	.80	1.55	.47	.72
1	2	4	1.53	.46	.93	1.35	.42	.84
1	3	5	1.25	.52	.92	1.13	.48	.83
1	3	6	1.11	.45	1.00	1.00	.40	.90
1	4	6	1.00	.53	.95	.92	.48	.87
1	4	8	.82	.50	1.02	.75	.43	.92

PROPORTIONS FOR ONE CU. YD. MORTAR					
MIXTURES		WET UN-RAMMED		RAMMED	
Cement	Sand	Cement Bbls.	Sand Cu. Yds.	Cement Bbls.	Sand Cu. Yds.
1	1.	4.7	.7	5.4	.8
1	1.5	3.7	.8	4.2	1.0
1	2.	3.0	.9	3.4	1.0
1	2.5	2.6	1.0	2.9	1.1
1	3.	2.2	1.0	2.5	1.1
1	3.5	1.9	1.0	2.2	1.2
1	4.	1.7	1.1	2.0	1.2
1	4.5	1.4	1.1	1.9	1.3

In many instances of special construction the majority of engineers and architects are strongly averse to the use of concrete, and to change this feeling the author has worked hard and with marked success for the last few years.

For silos, cisterns, live stock drinking troughs or feeding floors, liquid manure wells or sinks, sewers or conduits, where putrefaction or disease germs may generate, accumulate and flourish; and where a design is for terrazzo floors or platforms and special roofs; the author has used a concrete which in some of the warm countries of Europe has been called the du Mazuel oleaginous concrete.

This concrete is the ordinary kind to which, immediately after being mixed, non-volatile mineral oil is added in the proportion of 12 per cent. of oil by weight, to the weight of the cement, the mass being kept agitated for a few minutes after oil is added.

This concrete is very effective, as it is perfectly waterproof, shows no cracks known as "worm cracks", and gives a dustless, waterproof and in many instances acidproof surface. White oil may be substituted for non-volatile mineral oil when the latter cannot be procured. The oil slightly delays the initial and final setting. It also reduces the tensile strength in about the proportion which the amount of oil bears to the whole mass. The oil, alkalies and water form an emulsion which easily combine in the concrete. The mixing of non-volatile mineral oil with concrete is exceedingly simple.

WATER

Too little care is given to the water used by the average contractor or builder when making concrete. The author believes that a small percentage of the failures in concrete is due to that fact.

Only pure, clear water should be used in cements, mortars or concrete.

When the temperature is at 32 degrees Fahrenheit the contractor or builder should dissolve two pounds of pulverized calcium chloride ($CaCl_2$) in the water necessary for a batch, utilizing one barrel of hydraulic Portland cement; and for each degree under 32, the amount should be increased by two ounces of pulverized calcium chloride ($CaCl_2$).

The only effect that calcium chloride ($CaCl_2$) has on concrete, apart from preventing freezing, is to slightly retard the initial set, and at the same time to slightly increase its strength.

COMPARATIVE CONSTRUCTION COSTS

As the element of cost is always one of prime importance, the following table was carefully compiled to show at a glance the cost per cubic foot of various kinds of buildings actually constructed since 1905. In making estimates of cost all dimensions of the proposed building should be taken from extreme outside lines.

TABLE OF COMPARATIVE CONSTRUCTION COSTS

OF WELL BUILT STRUCTURES

FIGURES SHOW COST PER CUBIC FOOT, MEASUREMENTS BEING FROM EXTREME OUTSIDE LINES OF STRUCTURE

Kind of Building	Mud or Earth Tamped	Rough Log	First Class Frame	Second Class Frame	Third Class Frame	Fourth Class Frame	Brick	Brick and Frame	Non-reenforced Concrete	Hollow Tile and Concrete Block	Ordinary Reenforced Concrete and Steel	Masonry	Masonry and Concrete	DuMazuel Reenforced Concrete
Abattoirs	....	....	.14	....	...	....	.15	.145	.15	.15	.16	.16	.17	.13
Armories	....	....	.13	....	....	....	.14	.135	.14	.14	.15	.15	.16	.13
Asylums	....	....	.19	.18	.17	....	.20	.195	.21	.22	.24	.25	.26	.18
Barges	....	.19	.30	.28	.25	.24	....	....	....	....	.30	....	....	.26
Barns	.02	.03	.10	.08	.06	.04	.11	.10	.12	.09	.13	.14	.15	.05
Barracks	....	....	.15	.14	.13	....	.15	.145	.14	.14	.16	.165	.17	.13
Bath Houses	....	.04	.16	.15	.14	.13	.17	165	.16	.15	.25	26	.27	.12
Breweries	....	....	.20	.19	....	....	.22	.21	.195	.19	.23	.24	.23	.18
Bungalows	....	.08	.13	.12	.11	.10	.12	.115	.09	.09	.13	.14	.15	.09
Churches	....	.09	.16	155	.15	145	.16	.15	.19	.18	.23	.29	.28	.14
Colleges	....	.10	.29	.28	27	.26	.30	.28	.20	.23	.24	.40	.41	.18
Cottages	....	....	.25	24	.23	.22	.24	.23	.20	.19	.23	.25	.26	.19
Dams	.07	.08	....	....	....	.12	.14	...	.18	....	.19	.20	.19	.11
Dwellings	.05	.07	.26	.24	.15	.10	.22	.18	.18	.15	.19	.26	.27	.14
Factories	....	....	.15	.13	.105	.10	.19	.16	.14	.13	.18	.22	.21	.13
Flats	....	....	.17	.165	.16	.155	.17	.16	.16	.20	.36	.38	.39	.20
Fortifications	.02	.03	....	....	....	...	.06	....	.07	....	.08	.09	.09	.05
Garages	....	....	.12	11	....	....	.13	.14	.135	.13	.14	.15	.15	.09

TABLE OF COMPARATIVE CONSTRUCTION COSTS (Continued)

Figures Show Cost per Cubic Foot, Measurements being from Extreme Outside Lines of Structure

Kind of Building	Mud or Earth Tamped	Rough Log	First Class Frame	Second Class Frame	Third Class Frame	Fourth Class Frame	Brick	Brick and Frame	Non-reenforced Concrete	Hollow Tile and Concrete Block	Ordinary Reenforced Concrete and Steel	Masonry	Masonry and Concrete	DuMazuel Reenforced Concrete
Hospitals	....	....	.30	.28	.26	....	.29	.28	.29	.25	.30	.31	.32	.20
Hotels	....	..	.31	.25	.20	.15	.17	.16	.16	.15	.18	.35	.41	.15
Hot Houses	....	....	.25	.23	....	....	.26	.25	.25	.20	.21	.26	.27	.18
Libraries	....	....	.22	.21	.20	....	.22	.21	.20	.18	.22	.23	.25	.17
Mills	....	....	.20	.19	.18	.17	.21	.20	.20	.19	.22	.23	.25	.16
Municipal Buildings	....	....	.30	.28	.26	.24	.35	.34	32	.29	.36	.40	.42	25
Museums	....	....	.28	.27	.26	....	.30	.29	.29	.28	.31	.33	.34	.20
Power Houses	....	....	.19	.16	.14	....	.18	.16	.15	.16	.18	.20	.21	14
Prisons	....	...	....	....	....	...	.17	....	.18	....	.19	.19	.20	.14
Public Buildings	....	....	.16	.15	.14	....	.17	.16	.17	.15	.17	.18	.19	.12
Railway Stations	....	....	.19	.18	.17	.16	.20	.18	.17	.16	.20	.21	.22	.15
Reservoirs	.05	.07	....	....	....	....	.09	....	.10	....	.11	.11	.12	.08
Sewers (Large)	....	....	....	....	....	....	.10	....	.10	....	.13	.14	.15	.10
Skyscrapers (12 to 30 stories)	....	....	...	....	....	....	.28	....	....	.26	.40	.45	.50	.22
Stables	....	.10	.17	.16	.15	.14	.16	.15	.14	.15	.16	.18	.20	.14
Stores	....	.09	.18	.17	.16	.15	.16	.15	.16	.15	.17	.19	.20	.14
Temples	...	...	.26	.25	.24	....	.29	.28	.30	.28	.35	.38	.39	.17
Theatres	....	....	.30	.28	.26	.24	.30	.29	.26	.25	.31	.39	.40	.20
Warehouses	....	....	...	....	....	...	.18	....	.18	.17	.20	.21	.22	.16

DuMAZUEL REENFORCEMENTS

Du Mazuel reenforcements commend themselves by their great strength, light weight, perfect self-interlocking, low cost and adaptability to all constructions where concrete is to be used.

The great strength and light weight of these reenforcements are clearly shown when compared with others, as the lightest of constructions with other reenforcement capable of sustaining the same live loads, is more than five times the dead weight of the du Mazuel construction.

The low cost is also readily seen, as these reenforcements eliminate all form work, all skilled labor, reduce the whole dead weight of a building, and the plain reenforcement, even before any concrete is applied, forms a water-tight structure, a matter of great moment to contractors, who never have enough shelter for their materials.

The uses to which these reenforcements may be put are innumerable and here will be mentioned only a few of the places where their value has been demonstrated. A great many other uses for these materials will suggest themselves to the engineer, architect or designer.

All of the lighter gauges are especially adapted for reenforcing floors, roofs, walls, partitions, ceilings, buttresses, abutments, retaining walls, dams, penstocks, culverts, flues, chimneys, fire places, boiler settings, coal bins, hoppers, sidewalk slabs, etc. — even for reenforcing concrete canal boats and barges.

The heavier gauges are used to advantage for bridge work, sheet piling, coffer dams, tunnel tubing, trench and pit lining or sheeting, etc. These heavier gauges make light, stiff and inexpensive sheet pile, which requires no special tools, clips, joints, or shop work.

Plain du Mazuel reenforcement is furnished in United States standard gauges from number 18 to 28, inclusive; approximately one foot wide and up to twelve feet in length, the heavier gauges such as 18 and 20 being used for sheet piling.

The common radius of reversed "S" curves in du Mazuel reenforcement can be easily computed as follows:

g = width of section or half pitch.
r = common radius.
k = depth of reenforcement.

$$r = \frac{0.25\ (g^2 + k^2)}{k}$$

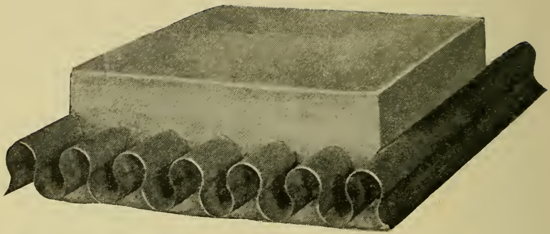
Expanded du Mazuel reenforcement is furnished in United States standard gauges from number 20 to 28; twelve inches and wider and eight feet in length.

Inquiries as to special requirements in either kind of reenforcement, as to gauge, width and length are given careful attention by the manufacturers.

All of the du Mazuel reenforcements are protected by patents in the United States and foreign countries.

USE WITHOUT FORMS

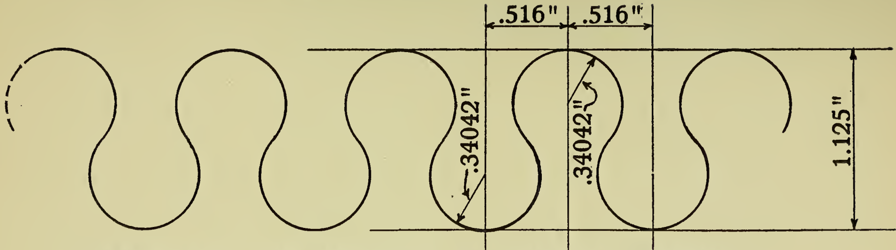
One of the greatest advantages possessed by the du Mazuel reenforcements is the ability to do without wooden or other forms. In tunnel and pipe work, these reenforcements may be used as an inside and outside form. If thick walls are to be constructed, it may be found economical to use the reenforcements simply as walls of a form, plastering the outsides and filling in between with concrete mortar.



View of a slab reenforced with Standard du Mazuel

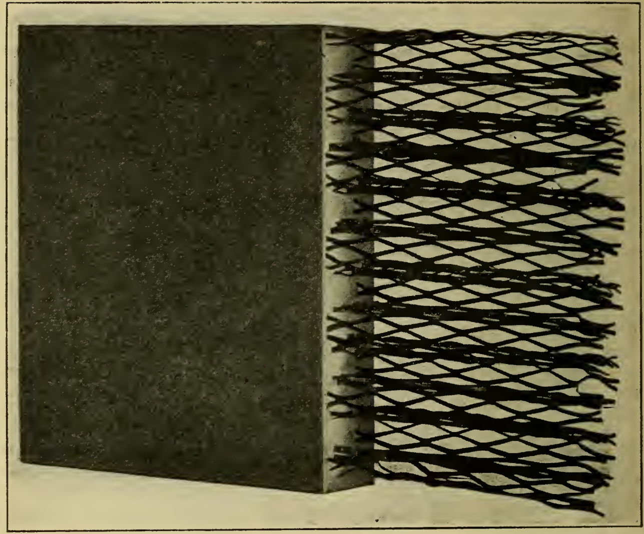
Reenforcement made of Plain Sheets

(Standard No. 22, or No. 24, or No. 26, or No. 28.)



STANDARD DU MAZUEL RE-ENFORCEMENT
MADE OUT OF PLAIN SHEETS
(Standards No. 22, No. 24, No. 26 and No. 28)

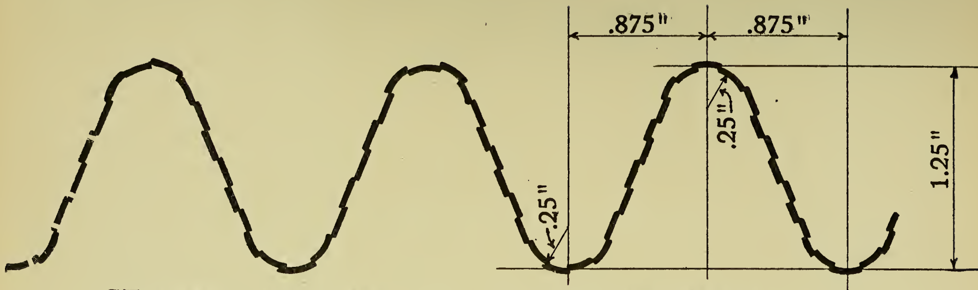
NOTE—The above give theoretical dimensions only.



View of slab reenforced with Standard du Mazuel Reenforcement

made of Expanded Metal

(Standard No. Ex18, or No. Ex20, or No. Ex22, or No. Ex24 or No. Ex26.)



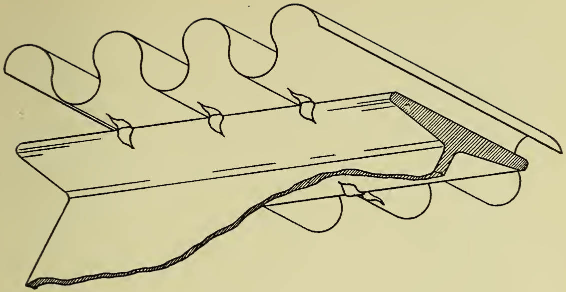
STANDARD DU MAZUEL RE-ENFORCEMENT
MADE OUT OF EXPANDED METAL

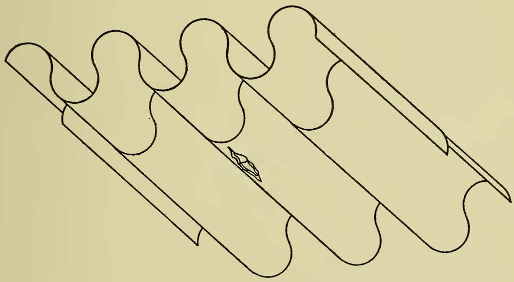
(Standards No. Ex18, No. Ex20, No. Ex22, No. Ex24 and No. Ex26)

NOTE—The above give theoretical dimensions only.

INTERLOCKING

In joining, overlapping or interlocking the du Mazuel reenforcements on the ends, the most convenient way will be found to press the reenforcement sheets into position with the foot, or with a mallet and wooden block. By placing one's heel against the outside corrugations of the top sheet, they will readily sink into place and start the interlocking of the adjacent corrugations. Some difficulty may be experienced if an attempt is made to interlock the entire width of the sheets at once, but by pressing the corrugations down consecutively no trouble will be found. When joining the sheets lengthwise, as the outside corrugation only is lapped, there is no difficulty in interlocking the entire length of the sheet at the same time.





THE DU MAZUEL RE-ENFORCEMENT CAN BE LAID ON TOP CORDS OF GIRDERS, WHERE THEY MAY BE SECURED BY TURNING BACK OVER FLANGE "TONGUES" CUT OUT FROM RE-ENFORCEMENT WITH A SHARP V-SHAPED CHISEL.

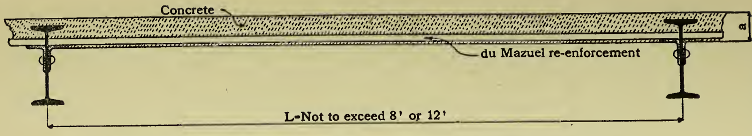
A SIMILAR BINDING CAN BE MADE TO FURTHER SECURE TWO RE-ENFORCEMENT SHEETS WHEN SAME ARE OVER-LAPPED BETWEEN SPANS.

FASTENING TO SUPPORTING STRUCTURE

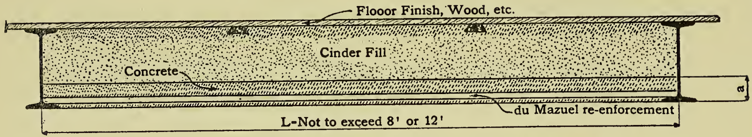
For floors and flat roofs, it will not be found necessary to fasten the du Mazuel reenforcement sheets to the beams, as the interlocking of the sheets has the effect of making them similar to one continuous sheet over the whole surface. The weight of the concrete on top and the plastering on the bottom and around the beams, effectively prevents any possibility of the floor sliding on the top cords of the beams. For pitch roofs, walls, partitions, etc., the sheets may be nailed or bolted to a furring strip on the purlins, columns or the like, or fastened as is ordinary corrugated iron. In cases of sewers, retaining walls, dams, etc., the materials may often be used as a portion of the original form as well as a reenforcement.

IS A FLOOR BEFORE CONCRETING

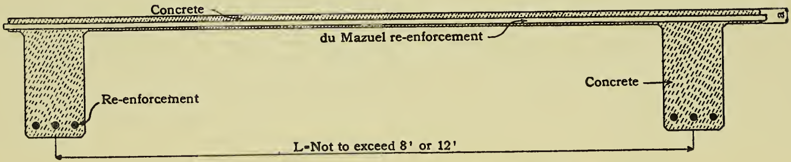
The du Mazuel reenforcements when used in roof and floor work, themselves act as a floor, on which the necessary work of depositing the concrete may be carried on without having other support. Unless long spans are used the du Mazuel reenforcements are amply strong to carry the load of workmen, wheelbarrows and materials. It is well, however, to use boards or planks for runways when wheelbarrows are used. For very long spans and the lighter gauges of material it will be found better to support the sheets as necessary with a light frame work at centre until the top coating of concrete has set.



SPAN RE-ENFORCED WITH DU MAZUEL RE-ENFORCEMENT CARRYING HEAVY LOADS AND ECONOMIZING HEAD ROOM.

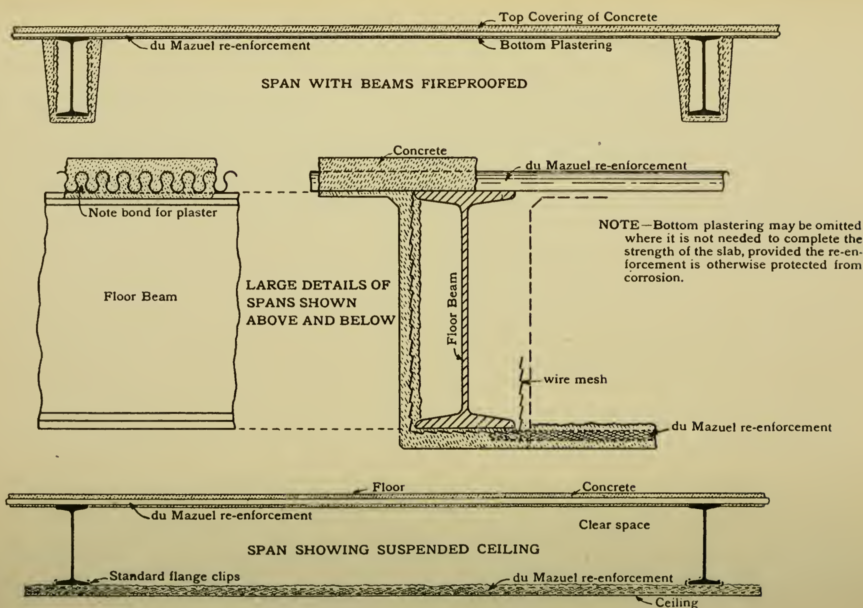


FLOOR SLAB RESTING ON BOTTOM FLANGES OF FLOOR BEAMS TO CARRY HEAVY LOADS.

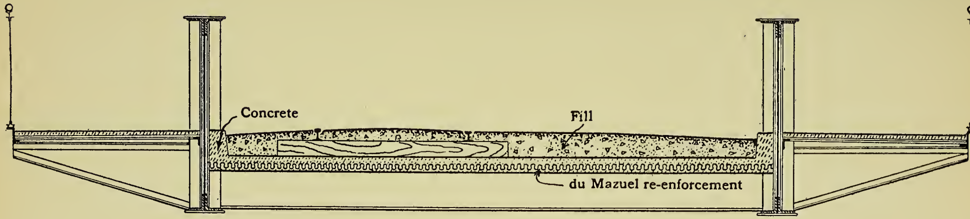


SPAN RE-ENFORCED WITH DU MAZUEL RE-ENFORCEMENT USED WITH CONCRETE BEAMS TO CARRY HEAVY LOADS.

a - Total thickness of Floor slab



DETAILS OF FLOORS THAT ARE TO CARRY HEAVY LOADS



CROSS SECTION OF HIGHWAY BRIDGE, FLOORS RE-ENFORCED WITH DU MAZUEL RE-ENFORCMENT.

FOR CULVERTS UP TO 8 FEET AND 12 FEET SPANS THIS RE-ENFORCEMENT MAY BE USED WITHOUT FLOOR BEAMS.

The du Mazuel reenforcements are furnished in plain or expanded metal sheets, either black, painted or unpainted, or galvanized. If black sheets are chosen they should receive the same care as in the handling of any other black sheet product. Sheet steel will corrode if left unpainted or unprotected; and where the material is likely to lay around for a considerable length of time before it is used, it is advisable to have the sheets painted, which can be done at a very small additional cost.

It is not best to leave the under side of the du Mazuel reenforcements unplastered, even in cases where the concrete on one side is sufficient to carry the loads required. No better protection for steel has ever been devised than a good coating of concrete. This is easily understood, as concrete made out of Portland or hydraulic cement maintains within itself a uniform alkaline reaction providing the free lime has not been removed by percolating waters, etc.; that is to say, as long as it remains a concrete body. To this end all porous materials, such as cinders, etc., should be avoided where the concrete is exposed to the elements.

In the case of a structure which is not intended to be permanent, the under side of the materials may be painted or galvanized, as either of these methods, if properly done, will enable them to withstand corrosion for a long time. This, of course, should be done only when the concrete on one side is sufficient to carry the load.

In plastering the under surface, care should be exercised to completely fill the corrugations, as in order to develop the full strength of the du Mazuel slabs, compression must occur along the diagonal lines connecting the centres of the circular parts of the corrugations. This compression in what is ordinarily the tension zone of a reenforced slab, is a peculiar feature of this reenforcement. The du Mazuel slabs cannot collapse unless the corrugations were to burst, or the concrete crush.

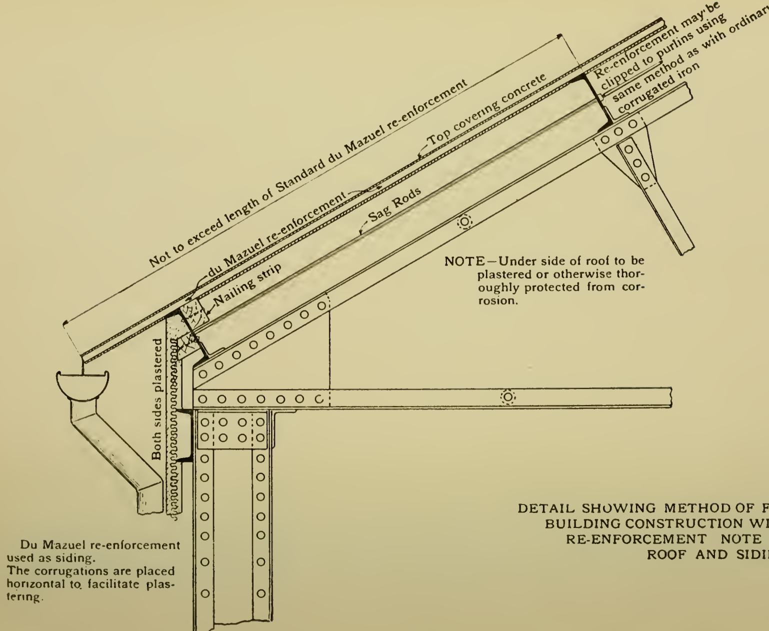
The plastering which is below the bottom of the corrugations is not to be considered, its purpose being merely to protect the metal against corrosion or fire. The depth to which this is put on is a matter of individual judgment. In the official fire and load tests on the du Mazuel reenforcements, the plastering extended three-eighths of an inch below the bottom of the corrugations.

In plastering, a one to two concrete mixture is recommended, with the addition of a small amount of metallurgical hair. Burnt lime may also be added in the proportion of one-tenth of the volume of cement used, but if the work is subject to hazardous fire conditions, it is better to use only the hair on account of the danger of dehydration of the lime, which will crumble upon losing its molecular moisture.

ROOFS — WATERPROOFING

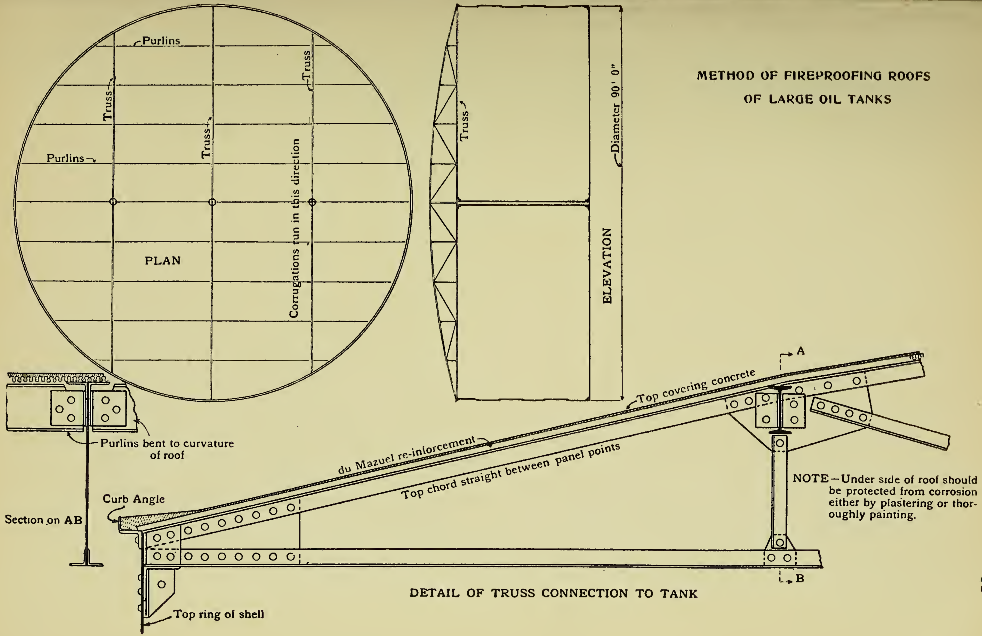
As a means of waterproofing as well as reenforcing a concrete structure, the du Mazuel reenforcements offer as perfect a system as has ever been devised. The interlocking features of the du Mazuel reenforcement made of plain sheets, make the joints practically watertight before even the concrete is applied. Engineers have found that for pitch roofs it is not necessary, if the work is properly done, to finish the surface with any sort of prepared roofing, felt or other waterproofing. These du Mazuel sheets without concrete offer a far more perfect cor-

(see page 33)

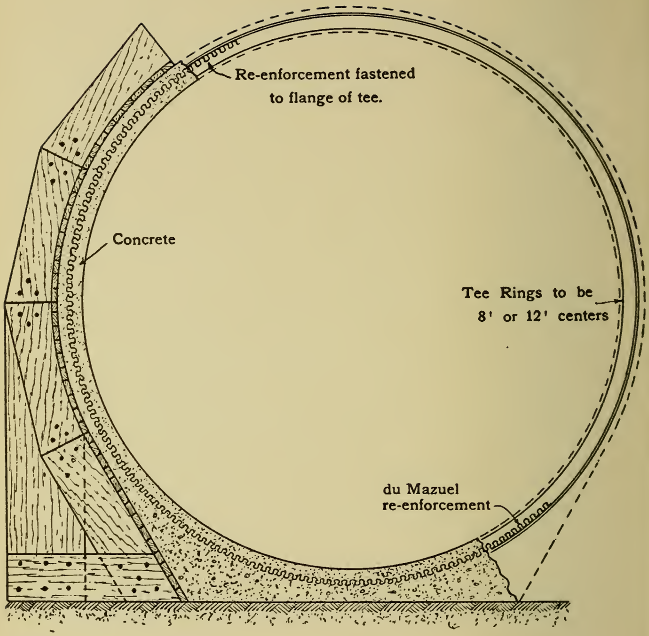


DETAIL SHOWING METHOD OF FIREPROOFING MILL BUILDING CONSTRUCTION WITH DU MAZUEL RE-ENFORCEMENT NOTE PERMANENT ROOF AND SIDING

METHOD OF FIREPROOFING ROOFS OF LARGE OIL TANKS



DETAIL OF TRUSS CONNECTION TO TANK



CONCRETE PIPE RE-ENFORCED AND INSIDE FORMS DONE AWAY WITH BY THE USE OF DU MAZUEL RE-ENFORCEMENT.

rugated roofing than the ordinary corrugated iron. The addition of the concrete to the top surface and the plaster to the bottom, preserves the sheets against any possibility of corrosion and makes a permanent and indestructible, acidproof, fireproof and waterproof roof.

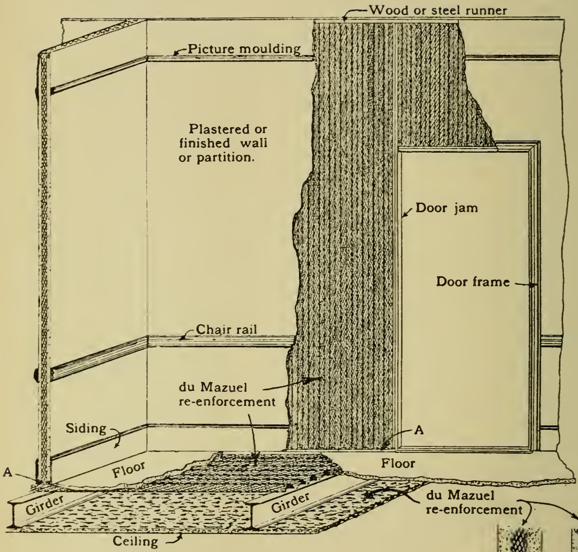
For flat roofs where water may accumulate it is desirable to cover the top coating of concrete with roof felt or prepared roofing or to finish with tar and gravel. The author on several occasions has waterproofed roofs by saturating every part of the surface, after it thoroughly dried, with hot paraffin wax, using hot irons to press in the wax. As the wax works its way in it will stop up all of the pores of the concrete, and form a perfect nonleakable surface that cannot be injured by frost or sun, and this at a very nominal cost.

A few suggestions as to roof details are shown on various plates herein. For such places as stack and ventilator openings, skylights, etc., the designer will find no more difficulty in flashing and waterproofing them than with any other form of roof.

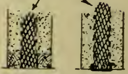
PARTITIONS

When du Mazuel expanded reenforcement is used for partition work, there is not only a great saving in the cost of the work, but also a great saving of time, as with this material the body of the wall is secured with the first coat of plaster.

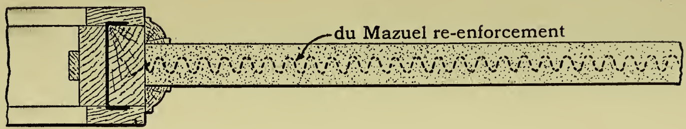
In using either kind of reenforcement for side walls or partitions they are preferably placed with the corrugations running horizontally, as they then present a more easily plastered surface.



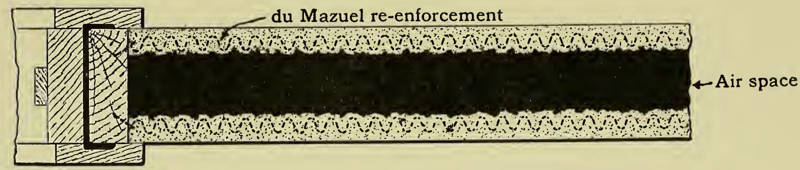
INTERIOR OF A ROOM SHOWING USES OF DU MAZUEL RE-ENFORCEMENT IN RESIDENCES, ETC.; AND, TYPICAL DETAIL OF FLOOR THAT IS NOT REQUIRED TO CARRY HEAVY LOADING.



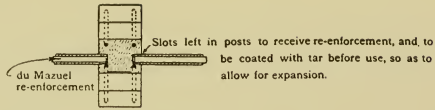
TWO DETAILS FOR A



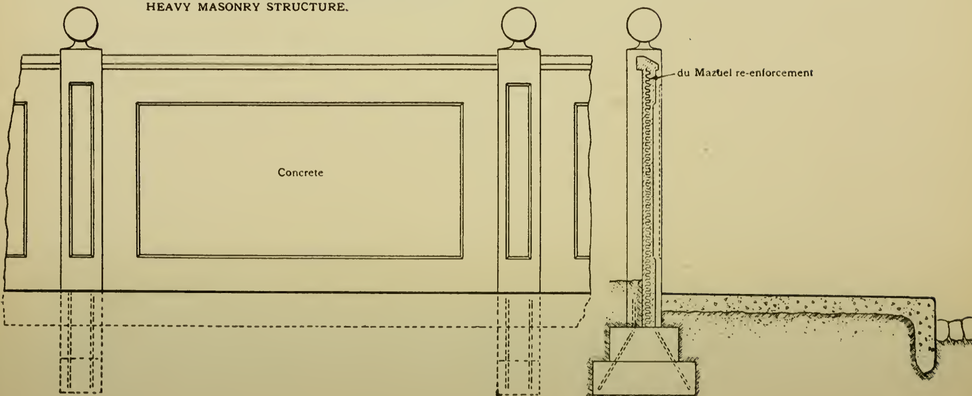
PLAN OF SINGLE PARTITION OR WALL SHOWING MEANS OF CONNECTION TO WINDOW OR DOOR FRAME

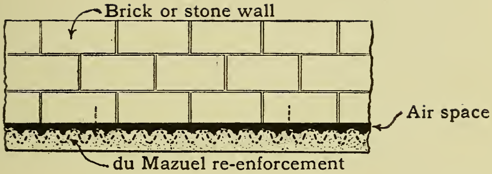


PLAN OF DOUBLE PARTITION OR WALL SHOWING MEANS OF CONNECTION TO WINDOW OR DOOR FRAME



AN ORNAMENTAL WALL 2" THICK, HAVING THE APPEARANCE AND THE STRENGTH OF A HEAVY MASONRY STRUCTURE.





PLAN SHOWING WALL WITH DU MAZUEL RE-ENFORCEMENT USED AS FURRING

THICKNESS OF WALLS IN INCHES, FOR MERCANTILE BUILDINGS AND LIVERY STABLES, AND, EXCEPT IN CHICAGO, FOR ALL BUILDINGS OVER FIVE STORIES IN HEIGHT.

Height of Building		Stories							
		1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.
Two Stories	Boston	16	12						
	New York	12	12						
	Chicago	12	12						
	Minneapolis	12	12						
	St. Louis	18	13						
	Denver	13	13						
	San Francisco	17	13						
	New Orleans	13	13						
Three Stories	Boston	20	16	16					
	New York	16	16	12					
	Chicago	16	12	12					
	Minneapolis	16	12	12					
	St. Louis	18	18	13					
	Denver	17	17	13					
	San Francisco	17	17	13					
	New Orleans	13	13	13					
Four Stories	Boston	20	16	16	16				
	New York	16	16	16	12				
	Chicago	20	16	16	12				
	Minneapolis	16	16	12	12				
	St. Louis	22	18	18	13				
	Denver	21	17	17	13				
	San Francisco	17	17	17	13				
	New Orleans	18	18	13	13				
Five Stories	Boston	20	20	20	20	16			
	New York	20	16	16	16	16			
	Chicago	20	20	16	16	16			
	Minneapolis	20	16	16	12	12			
	St. Louis	22	22	18	18	13			
	Denver	21	21	17	17	13			
	San Francisco	21	17	17	17	13			
	New Orleans	18	18	18	13	13			
Six Stories	Boston	24	20	20	20	20	16		
	New York	24	20	20	20	16	16		
	Chicago	20	20	20	16	16	16		
	Minneapolis	20	20	16	16	16	12		
	St. Louis	26	22	22	18	18	13		
	Denver	26	21	21	17	17	13		
	San Francisco	21	21	17	17	17	13		
	New Orleans	22	18	18	18	13	13		
Seven Stories	Boston	24	20	20	20	20	20	16	
	New York	28	24	24	20	20	16	16	
	Chicago	20	20	20	20	16	16	16	
	Minneapolis	20	20	20	16	16	16	12	
	St. Louis	26	26	22	22	18	18	13	
	Denver	26	21	21	21	17	17	17	
	New Orleans	22	22	18	18	18	13	13	
Eight Stories	Boston	28	24	20	20	20	20	20	16
	New York	32	28	24	24	20	20	16	16
	Chicago	24	24	20	20	20	16	16	16
	Minneapolis	24	20	20	20	16	16	16	12
	St. Louis	30	26	26	22	22	18	18	13
	Denver	30	26	21	21	21	17	17	17
	New Orleans	22	22	22	18	18	18	13	13

Height of Building		Stories 1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.
Nine Stories	Boston.....	28	24	24	20	20	20	20	20	16			
	New York...	32	32	28	24	24	20	20	16	16			
	Chicago.....	24	24	24	20	20	20	16	16	16			
	Minneapolis .	24	24	20	20	20	16	16	16	12			
	St. Louis....	30	30	26	26	22	22	18	18	13			
	Denver.....	30	26	26	21	21	21	17	17	17			
Ten Stories	Boston.....	28	28	24	24	20	20	20	20	20	16		
	New York...	36	32	32	28	24	24	20	20	16	16		
	Chicago.....	28	28	24	24	24	20	20	20	16	16		
	Minneapolis.	24	24	24	20	20	20	16	16	16	12		
	St. Louis....	34	30	30	26	26	22	22	18	18	13		
	Denver.	30	30	26	26	21	21	21	17	17	17		
Eleven Stories	Boston.....	36	32	32	28	28	24	20	20	20	20	16	
	New York...	36	36	32	28	28	24	24	20	20	16	16	
	Chicago.....	28	28	24	24	24	20	20	20	16	16	16	
	St. Louis....	34	34	30	30	26	26	22	22	18	18	13	
	Denver.	30	30	26	26	26	21	21	21	17	17	17	
Twelve Stories	Boston.....	36	36	32	32	28	28	24	20	20	20	20	16
	New York...	40	36	36	32	32	28	24	24	20	20	16	16
	Chicago.....	28	28	28	24	24	24	20	20	20	16	16	16
	St. Louis....	34	34	34	30	30	26	26	22	22	18	18	13
	Denver.....	30	30	30	26	26	26	21	21	21	17	17	17

THICKNESS OF ENCLOSING WALLS, FOR RESIDENCES, TENEMENTS, HOTELS, AND OFFICE BUILDINGS—CHICAGO BUILDING ORDINANCE

	Basement.	Stories 1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.
Basement and.	12	8											
Two-story.........	12	12	8										
Three-story.......	16	12	12	8									
Four-story.	20	16	16	12	12								
Five-story........	20	16	16	16	12	12							
Six-story..........	20	20	16	16	16	12	12						
Seven-story.......	24	24	20	20	16	16	12	12					
Eight-story.......	24	24	24	20	20	16	16	12	12				
Nine-story........	28	24	24	20	20	20	16	16	12	12			
Ten-story.........	28	24	24	24	20	20	20	16	16	12	12		
Eleven-story......	28	28	24	24	24	20	20	20	16	16	12	12	
Twelve-story.	32	28	28	24	24	24	20	20	20	16	16	12	12

NOTES
ON THE DESIGN OF FLOORS

The following are the usual assumptions made in good practice for superimposed loads on floors.

STANDARD LOADING

Dwellings and offices; 70 pounds per square foot.

Churches, theatres and ball rooms; 125 pounds per square foot.

Warehouses and factories; 200 to 250 pounds per square foot.

Heavy machinery; not less than 250 pounds per square foot.

It will usually be found that the building laws of various cities conform to the above.

FLOOR FINISH

For determining the dead loads of the different kinds of floor finish, the following weights per square foot may be used:

Spruce, ⅞″; 2.1 pounds per square foot.

Southern pine or maple, ⅞″; 4 pounds per square foot.

Sleepers, 3″ x 4″, 16″ centers; 2.5 pounds per square foot.

Marble, 1″ thick; 14 pounds per square foot.

Cinder fill, per inch; 4 pounds per square foot.

Cinder concrete, per inch; 8 pounds per square foot.

Suspended ceilings; 10 to 20 pounds per square foot.

Plaster, ¼″; 2 to 4 pounds per square foot.

SPACING OF STRUCTURAL MEMBERS

The du Mazuel reenforcements being furnished in sheets of any length up to 8 feet in the expanded and 12 feet in the plain form, the designer is able to space the columns, uprights, girders, etc., in the most economical manner. The du Mazuel sheets are laid directly against the structural members, which may be of any standard section and fastened as previously described, no furring or intermediate supports being required. In plastering the sides or undersides care should be taken to work the mortar well into the corrugations along and against the structural members.

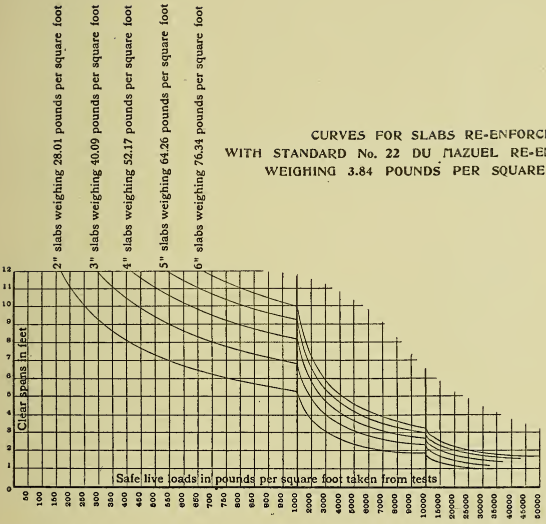
SAFE LIVE LOADS,
DEAD LOADS, WEIGHTS, ETC.

The diagrams or curves given in this Manual are constructed upon well known formulae, using coefficients that are universally accepted as safe for conditions to which they are intended to apply, and furthermore are primarily made from actual tests.

These diagrams or curves, giving not only the weight of the reenforcements, the dead weight of the various slabs, but also the safe live loads per square foot for given spans, will enable the engineer, architect or designer to quickly and accurately fill his requirements without the usual lengthy and tedious calculations.

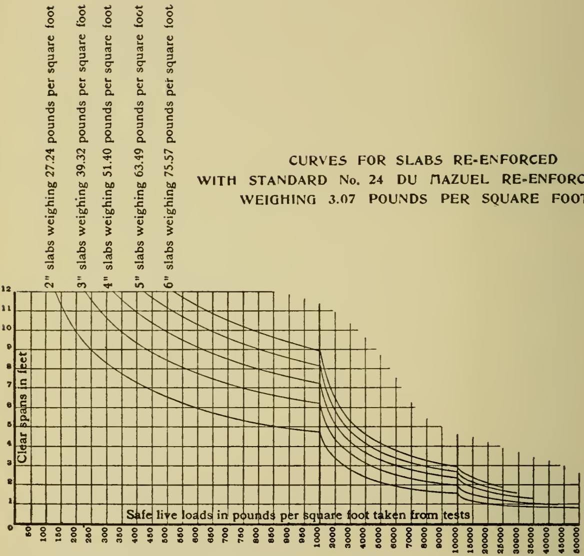
In all general cases it will be found that a considerable saving on the total cost of construction, as well as a great saving on the floors and slabs themselves, can be effected in the design of the steel supporting structure, due to the reduction of the dead load of the floors and slabs, when these are designed to use the du Mazuel system.

CURVES FOR SLABS RE-ENFORCED WITH STANDARD No. 22 DU MAZUEL RE-ENFORCEMENT WEIGHING 3.84 POUNDS PER SQUARE FOOT.



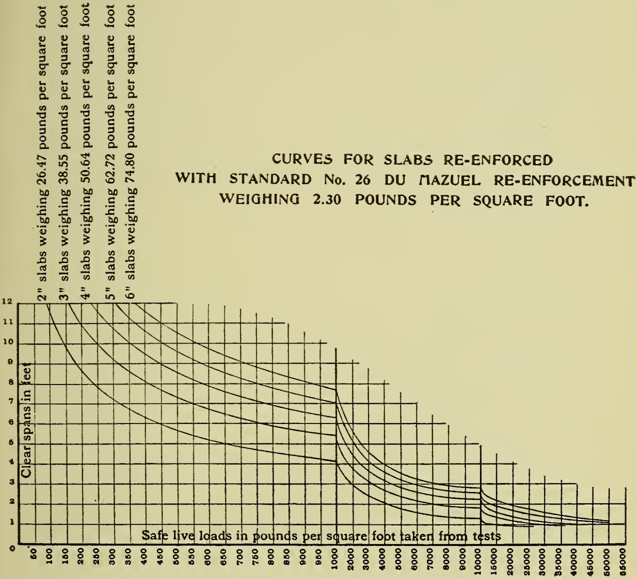
NOTE—For slabs re-enforced with standard No. Ex18 du Mazuel re-enforcement take two-thirds of given loads as safe live loads.

CURVES FOR SLABS RE-ENFORCED WITH STANDARD No. 24 DU MAZUEL RE-ENFORCEMENT WEIGHING 3.07 POUNDS PER SQUARE FOOT.

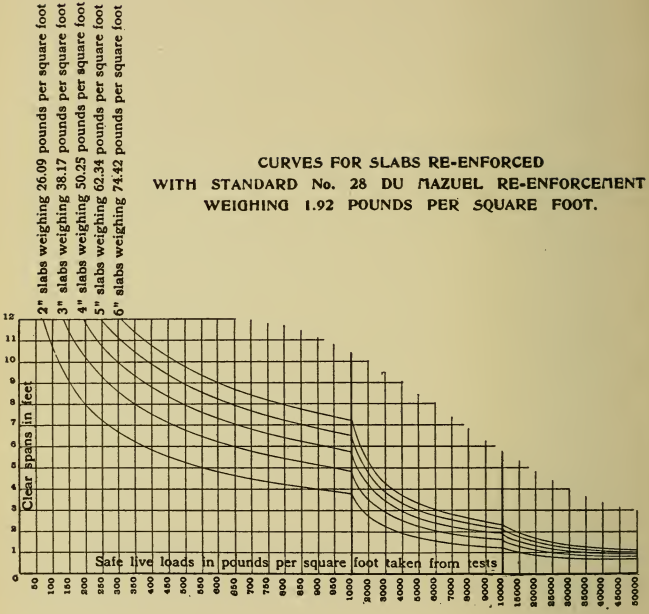


NOTE—For slabs re-enforced with standard No. Ex20 du Mazuel re-enforcement take two-thirds of given loads as safe live loads.

CURVES FOR SLABS RE-ENFORCED WITH STANDARD No. 26 DU MAZUEL RE-ENFORCEMENT WEIGHING 2.30 POUNDS PER SQUARE FOOT.



NOTE—For slabs re-enforced with standard No. Ex22 du Mazuel re-enforcement take two-thirds of given loads as safe live loads.



NOTE—For slabs re-enforced with standard No. Ex24 du Mazuel re-enforcement take two-thirds of given loads as safe live loads.

NOTE

It must be borne in mind if du Mazuel Reenforcement made of expanded metal is selected for reenforcing floor and roof slabs, that these slabs do not reach their full bearing capacity before thirty to ninety days have elapsed after initial set of the concrete.

All of the curves refer to du Mazuel slabs of 1 to 3 stone concrete. L represents the clear span in feet; a, the thickness of slab in inches; and b, 0.5791 inch, see pages 52 and 53.

WOODEN BEAMS

The accompanying tables are calculated on a basis of a maximum fibre strain of 1,000 pounds per square inch of material, or one-tenth of the breaking strain of spruce.

Floor loads as indicated.

The length or span of rafter or floor beam in these tables is the clear length between supports. In rafters with collar beams, and without tie at the plate level, the length is to be taken as the length from the ridge to the point of connection of the collar beam, unless this is more than five times the distance on the rafter from the collar beam to the plate, in which case five times the latter distance is to be taken as the span in determining the distance between centers.

Distance between centres for other thicknesses of beams or other unit strains will vary in direct proportion to the increase or decrease. Thus, 3"x4" rafters at 1000 lbs. per square inch of material and 30 lbs. per square foot of roof may be put at 11" centres for 14 feet span, or 1½ of 7.3" as given for 2"x4" in the table. For 1500 lbs. instead of 1000 lbs. per square inch of material, a further increase of 50 per cent. may be made, and the centre distance becomes 16.5 inches.

Load, 30 lbs. per Sq. Ft. (Ordinary roof load.)

Span, feet, / Size of Beam.	6	8	10	12	14	16	18	20	22	24	26	28
	Distance between centres of beams in inches.											
2 × 4	39.5	22.2	14 2	9.9	7.3	5.6						
2 × 5	..	34.7	22.2	15.4	11.3	8 7	6.9					
2 × 6	....	....	32.0	22.2	16.3	12.5	9.9	8.0				
2 × 7	..	..	..	30.2	22.2	17.0	13.4	10.9	9.0			
2 × 8	..	..	..	..	29 0	22 2	17.5	14.2	11 7	9 9		
2 × 9	....	....	....	....	....	28.1	22.2	18.0	15.0	12.5	10 6	
2 × 10	..	..	..	..	..	34.7	27.4	22.2	18.4	15.4	13 1	11 3
2 × 12	..	..	..	..	..	..	39 5	32 0	26.4	22.2	19 0	16.4

Where plastering is to be used, beams should be figured for stiffness, instead of as in table; and at 15" centres, depth in inches should equal one-half of length in feet when beams are 2" thick.

Load, 40 lbs. (Heavy roof load allowance.)

Size of Beam	6	8	10	12	14	16	18	20	22	24	26	28
2 × 4	29.6	16.7	10.7	7 4								
2 × 5	..	26.0	16.7	11.5	8.5							
2 × 6	..	..	24.0	16.7	12.3	9.4						
2 × 7	....	....	....	22.7	16.7	12.8	10.1					
2 × 8	..	..	..	..	21.8	16.7	13.2	10 6				
2 × 9	..	..	..	..	..	21.1	16.7	13.5	11.1			
2 × 10	....	....	....	....	....	....	20.6	16.7	13.8	11.6		
2 × 12	..	..	..	..	..	..	..	24.0	19.8	16 7	14.2	
2 × 14	..	..	..	..	..	..	..	..	27.0	22.7	19.3	16 7

For plastering, when distance between centres equals 20", depth of beam in inches should equal six-tenths of span in feet.

Load, 50 lbs. (Dwelling house floor allowance.)

Size of Beam	6	8	10	12	14	16	18	20	22	24	26	28
2 × 4	23.7	13.3	8.5									
2 × 5	..	20.8	13.3	9.3								
2 × 6	..	..	19.2	13.3	9.8							
2 × 7	....	....	26.1	18.1	13.3	10.2						
2 × 8	..	..	...	23 7	17.4	13.3	10 5					
2 × 9	..	..	..	..	22.0	16.9	13.3	10.8				
2 × 10	....	....	....	....	....	20.8	16.5	13.3	11.1	9.3		
2 × 12	..	..	..	..	..	..	23.7	19.2	15 8	13.3	11 3	
2 × 14	..	..	..	..	..	..	..	26.1	21.6	18.2	15.4	13.3

For plastering, when distance between centres equals 16", depth of beam in inches should equal six-tenths of span in feet.

6 8 10 12 14 16 18 20 22 24 26 28

Load	Span, feet, / Size of Beam.	6	8	10	12	14	16	18	20	22		
		Distance between centres of beams in inches.										
Load, 100 lbs.	2 × 4	11.9									*Stiff enough for plastering.*	(Theatre floor.)
	2 × 5	18.6	10.4									
	2 × 6	26.7	15.0	9.6								
	2 × 7	....	20.4	13.1	9.1							
	2 × 8	..	26.7	17.6	11.8	8.7						
	2 × 9	..	...	21.1	15.0	11.0						
	2 × 10	....	....	26.7	18.6	13.7	10.5					
	2 × 12	..	..	..	26.7	19.6	15.0	11 8	9.6			
	2 × 14	..	..	..	..	26.7	20 5	16.2	13.1	10 8		
Load, 150 lbs.	2 × 5	12.7	6.9								*Stiff enough for plastering.*	(Warehouse.)
	2 × 6	17.7	10.0	6.4								
	2 × 7	24.0	13.6	8.7	6.0							
	2 × 8	....	17 7	11.3	7 9	5.8						
	2 × 9	..	22.4	14.3	10.0	7.3	5.6					
	2 × 10	..	27.7	17.7	11 8	9.3	6.9	5.5				
	2 × 12	....	....	25.5	17.7	13.0	10.0	7.9	6 4			
	2 × 14	..	..	..	24 0	17.7	13 5	10.7	8.7	7.2		
	2 × 16	..	..	..	..	23 1	17.7	14.0	11.3	9.4		
Load, 200 lbs.	3 × 5	13.8									*Stiff enough for plastering.*	(Warehouse.)
	3 × 6	20.0	11.3									
	3 × 7	27.2	15 3	9.8								
	3 × 8	35.6	20.0	12.8	8.9							
	3 × 9	..	25.2	16.2	11.3	8.3						
	3 × 10	..	31 2	20.0	13.8	10.2	7.8					
	3 × 12	....	....	28.8	20.0	14.7	11.3	8 9				
	3 × 14	..	..	..	27.2	20 0	15.3	12.6	9.8			
	3 × 16	..	..	..	..	26.1	20.0	15.8	12 8	10 5		
Load, 250 lbs.	3 × 5	11.1									*Will answer for plastering?*	(Warehouse, N. Y. Regulation.)
	3 × 6	16.1	9 0									
	3 × 7	21.9	12.3	7.8								
	3 × 8	28.5	16 1	10.2	7.1							
	3 × 9	36.0	20.3	13.1	9.0	6 6						
	3 × 10	..	25.1	16.1	11.1	8.1	6.3					
	3 × 12	....	36 0	23.1	16.1	11 9	9.0	7.2				
	3 × 14	..	..	31 5	21 8	16.1	12 3	9.8	7.8			
	3 × 16	..	..	..	28.5	20.8	16.1	12 8	10 2	8.6		
Load, 300 lbs.	3 × 6	13.4									*Will answer for plastering.*	(Warehouse.)
	3 × 7	18.2	10.2									
	3 × 8	23.7	13.4	8.6								
	3 × 9	30.0	17 0	10.8	7.5							
	3 × 10	37.1	20.9	13.4	9.3	6.8						
	3 × 12	....	30 0	19 2	13.4	9.8	7.5					
	3 × 14	..	..	26 1	18.2	13.4	10.2	8.0				
	3 × 16	..	..	..	23.7	17.4	13.4	10 5	8.6			
		6	8	10	12	14	16	18	20	22		

CONCRETE MEMBERS

How to Calculate Them When Subjected to Various Exterior Forces

It would be a waste of time trying to learn to calculate concrete when in a mass state, that is, without reenforcement. When a member is reenforced, whatever kind of reenforcement may be used, the important point is to get this member to sustain safely the loads required with the least amount of concrete and steel reenforcement, thereby reducing the dead weight of the construction. For this purpose good judgment and a careful analysis of the member under consideration is necessary.

Taking, for instance, a slab resting upon two parallel beams or supports, imagine a rectangular slice cut from this slab at right angles to the beams and that this slice is then cut crosswise in the center or at half span. We then have to consider the cross-section at the weakest point of the concrete slab and have to find the amount of steel required over said span, within the considered slice, to carry the necessary load. This is done easily by the formulae on the accompanying plates. Naturally this slab is to be uniformly reenforced the same as at this considered section.

The calculations can then be readily computed, and if one were to use any kind of steel reenforcement other than the du Mazuel reenforcement the

(see page 55)

DOCTOR DU MAZUEL'S FORMULAE.

NOTE—When representing dimensions Capitals are for feet and decimals of a foot, and Small Letters for inches and decimals of an inch.

S =65,000. Modulus of rupture for steel, per square inch. Generally divided by required factor of safety.

Θ =29,000,000. Modulus of elasticity for steel.

Σ =4,640,000. Modulus of elasticity for 1:3 stone (the stone passing through 1/4 inch mesh screen) concrete, 90 days old, under pressure of 2,000 to 3,000 pounds per square inch.

Ω =215. Safe compression stress per square inch of above referred-to concrete.

W′=Uniformly distributed load per square foot, including the weight of du Mazuel re-enforced concrete, per square foot.

Δ =Area of steel in considered section of du Mazuel re-enforced concrete, in square inches.

a =Depth of du Mazuel re-enforced concrete section.

b =To be always greater than radius of reversed curve in du Mazuel re-enforcement.

c =Depth to plane of apexes of upward forces in du Mazuel re-enforcement.

f =Maximum height from plane of apexes of upward forces in du Mazuel re-enforcement to the minimum theoretical plane or compression area of considered re-enforced concrete section.

e =c minus f.

g =Width of considered du Mazuel re-enforced concrete section.

L =Span of the du Mazuel re-enforced concrete member in feet.

l =Span of the du Mazuel re-enforced concrete member in inches.

Π =Coefficient in computations for reductions to foot width of considered section.

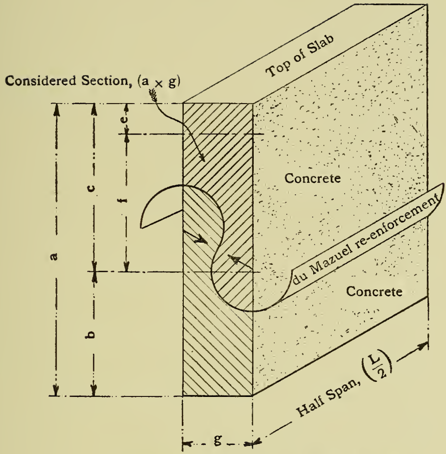
m =Bending moment in inch pounds.

d =Deflection. When deflection exceeds $\frac{l}{360}$, decrease the value of W′ in proportion.

Z =Section modulus.

I′ =Moment of inertia of re-enforced concrete considered section (a × g).

S′= Modulus of rupture for compound material used, per square inch.



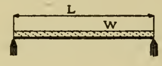
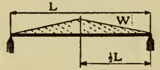
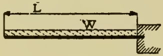
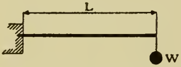
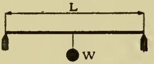
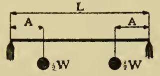
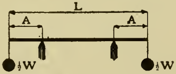
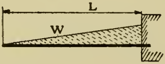
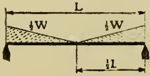
W = Uniformly distributed load per square foot.

$$\Pi = \frac{12}{g}; \quad f = \frac{c}{\frac{\Theta\Omega}{\Sigma S} + 1};$$

$$W' = \frac{\Pi S}{4.5 L^2} \left\{ \frac{e^3 \Sigma}{\Theta f} + 3 f \Delta \right\};$$

$$m = \frac{3 W L^2}{2}; \quad Z = \frac{3 W L^2}{2 S'}$$

$$d = \frac{15 \Pi W' f l^4}{384 \Delta \Sigma \Theta I'}$$

Method of Loading		Maximum Bending Moment		Maximum Load W	Deflection d.	Section modulus Z
Length in feet	Load in pounds	Ft. Lb. M	In. Lb. m	Lb.	In.	———
		$\frac{WL}{8}$	$\frac{3\ WL}{2}$	$\frac{2\ ZS}{3L}$	$\frac{5\ Wl^3}{384EI}$	$\frac{3\ WL}{2S}$
		$\frac{WL}{6}$	2 WL	$\frac{ZS}{2L}$	$\frac{Wl^3}{60EI}$	$\frac{2WL}{S}$
		$\frac{WL}{2}$	6WL	$\frac{ZS}{6L}$	$\frac{Wl^3}{8EI}$	$\frac{6WL}{S}$
		WL	12WL	$\frac{ZS}{12L}$	$\frac{Wl^3}{3EI}$	$\frac{12WL}{S}$
		$\frac{WL}{4}$	3 WL	$\frac{ZS}{3L}$	$\frac{Wl^3}{48EI}$	$\frac{3WL}{S}$
		$\frac{WA}{2}$	6WA	$\frac{ZS}{6A}$	$\frac{Wa}{48EI} \times (3l^2-4a^2)$	$\frac{6WA}{S}$
		$\frac{WA}{2}$	6WA	$\frac{ZS}{6A}$	$\frac{Wa}{16EI} \times (l-2a)^2$ Between Supports	$\frac{6WA}{S}$
		$\frac{WL}{3}$	4WL	$\frac{ZS}{4L}$	$\frac{Wl^3}{15EI}$	$\frac{4WL}{S}$
		$\frac{WL}{12}$	WL	$\frac{ZS}{L}$	$\frac{3Wl^3}{320EI}$	$\frac{WL}{S}$

L=span in feet; l=span in inches; W=total load in pounds; E=modulus of elasticity; I=moment of inertia; Z=section modulus; S=safe stress on the extreme fibres of the beam section. In figuring deflections, all lengths must be expressed in inches. Small letters are used to represent inches, and capitals to represent feet.

Delta ($\triangle$) would represent the area of steel of the considered section while the distances *c, b* and *f* would refer to the ordinary theoretical center of gravity of the reenforcing member's cross section; in the case of a round bar being used, the center of said bar being the center of gravity of its cross section.

All members or parts of a concrete structure can be similarly analyzed.

In the case of a column, the height being expressed in feet and the radius of gyration in inches and used respectively as the numerator and denominator of a fraction, such a radius of gyration should be chosen as will make the fraction equal one as nearly as possible.

Definitions, together with the formulae, are given in the following pages for finding the sections required under various conditions. Tables of properties of Carnegie standard and special sections are also furnished, by the aid of which beams may be quickly and accurately proportioned.

The use of these tables is fully explained by an example showing clearly how to determine beam sections required for both uniform and non-uniform loads.

DEFLECTION

Deflection is the tendency of a beam or slab to bend under loads.

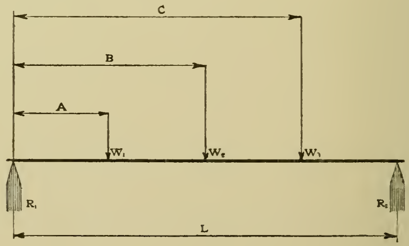
In some instances deflection, rather than absolute strength, may be the governing consideration in determining the size of a beam to be used. For beams carrying plastered ceilings, for example, it has been found by practical tests that, if the deflection exceeds 1/360 of the distance between the supports, there is danger of the ceiling cracking.

For deflections due to different systems of loading see plate of formulae for beams under ordinary loadings.

REACTIONS

Reaction is the force that supports the beam at a point. The sum of the reactions is always equal to the sum of the loads on the beam plus the weight of the beam itself.

The accompanying figure represents a beam supported on reaction 1 and reaction 2, and loaded in a uniform or non-uniform manner; the loads being represented by W_1, W_2, W_3, at distances A, B and C, from reaction 1.



As the reaction at either support is the sum of the loads multiplied by their respective distances to the opposite reaction, and divided by the distance between the reactions, we have the following formulae:

$$R_2 = \frac{(W_1 \times A) + (W_2 \times B) + (W_3 \times C)}{L}$$

$$R_1 = (W_1 + W_2 + W_3) - R_2$$

SHEAR

Shear is that tendency to divide or cut a member or beam across its fibres when same is subjected to a force. At any section of the beam the shear equals either reaction minus the sum of the loads between that reaction and the section considered. The maximum shear, which is always the one taken into consideration, is equal to the larger reaction.

BENDING MOMENTS

Bending moment is the force which, when exerted on a beam, will force the beam to bend or deflect. It is therefore necessary to find the maximum bending moment to which a beam can be subjected. To find the maximum bending moment, find the reactions and calculate the moments around each load, the greater moment being the maximum bending moment.

Referring to the figure just now considered, we therefore have:

Bending moment at W_1,
equals $R_1 \times A$;
Bending moment at W_2,
equals $R_1 \times B - W_1 \times (B - A)$;
Bending moment at W_3,
equals $R_1 \times C - W_2 \times (C - B) - W_1 \times (C - A)$;
or, equals $R_2 \times (L - C)$;
and so on.

SECTION MODULUS

The section modulus may be used in determining the section required. The section modulus is equal to the maximum bending moment expressed in inch pounds "m", divided by the safe stress of the extreme fibres of the beam considered "S"; in other words, divided by a safe working factor of the material used.

$$\text{Section Modulus} = Z = \frac{m}{S}$$

SAFE WORKING FACTORS

A safe working factor is that fraction of ultimate load which is allowed per square inch of material.

The working factors commonly used for steel are as follows:

Private residences; 20,000 pounds.
Office and apartment buildings; 16,000 pounds.
Factory and heavy construction; 14,000 pounds.
Rolling loads, as in bridges, etc.; 12,000 pounds.
Mills subjected to heavy shocks; 8,000 pounds.

EXPLANATION OF TABLES OF PROPERTIES OF CARNEGIE STANDARD AND SPECIAL I-BEAMS AND CHANNELS

The tables on I-beams and channels are calculated for all weights to which each pattern is rolled.

Columns 8 and 9 give coefficients by means of which the safe, uniformly distributed load may be readily and quickly determined. To do this it is only necessary to divide the coefficient given by the span or distance in feet between supports. Therefore if, as will usually be the case, a section or beam is to be selected with a safe working factor of 12,500 or 16,000 pounds, for carrying a certain load for a length of span already determined upon, it will only be necessary to ascertain the coefficient which this load and span will require and refer to the table, columns 8 and 9, for a section having a coefficient of this value. The coefficient is obtained by multiplying the uniformly distributed load in pounds by the span length in feet. In case the load is concentrated at the middle of the span, multiply the load by 2 and then consider it as uniformly distributed.

However, if other safe working factors are selected, and for other cases of loading, one has to obtain the maximum bending moment in inch pounds and divide it by the selected safe working factor. This will give the section modulus "Z", when reference should be made to column 7 in table of properties for the required beam.

These tables have all been prepared with great care. No approximation has entered into any of the calculations, therefore the figures given may be relied upon as accurate.

PROPERTIES OF I-BEAMS

1	2	3	4	5	6	7	8	9
Depth of Beam Inches	Weight per Foot Pounds	Area of Section Square Inches	Thickness of Web Inches	Width of Flange Inches	Mom. of Inertia Neutral Axis Perpendicular to Web at Center I	Section Modulus Neutral Axis Perpendicular to Web at Center Z	Coefficient of Strength for Fiber Stress of 16,000 lbs. per sq. in. Used for Buildings C	Coefficient of Strength for Fiber Stress of 12,500 lbs. per sq. in. Used for Bridges C'
24	100.00	29.41	0.754	7.254	2380.3	198.4	2115800	1653000
	95.00	27.94	0.692	7.192	2309.6	192.5	2052900	1603900
	90.00	26.47	0.631	7.131	2239.1	186.6	1990300	1554900
	85.00	25.00	0.570	7.070	2168.6	180.7	1927600	1505900
	80.00	**23.32**	**0.500**	**7.000**	**2087.9**	**174.0**	**1855900**	**1449900**
20	100.00	29.41	0.884	7.284	1655.8	165.6	1766100	1379800
	95.00	27.94	0.810	7.210	1606.8	160.7	1713900	1339000
	90.00	26.47	0.737	7.137	1557.8	155.8	1661600	1298100
	85.00	25.00	0.663	7.063	1508.7	150.9	1609300	1257200
	80.00	**23.73**	**0.600**	**7.000**	**1466.5**	**146.7**	**1564300**	**1222100**
20	75.00	22.06	0.649	6.399	1268.9	126.9	1353500	1057400
	70.00	20.59	0.575	6.325	1219.9	122.0	1301200	1016600
	65.00	**19.08**	**0.500**	**6.250**	**1169.6**	**117.0**	**1247600**	**974700**
18	70.00	20.59	0.719	6.259	921.3	102.4	1091900	853000
	65.00	19.12	0.637	6.177	881.5	97.9	1044800	816200
	60.00	17.65	0.555	6.095	841.8	93.5	997700	779500
	55.00	**15.93**	**0.460**	**6.000**	**795.6**	**88.4**	**943000**	**736700**
15	100.00	29.41	1.184	6.774	900 5	120.1	1280700	1000600
	95.00	27.94	1.085	6.675	872.9	116.4	1241500	969900
	90.00	26.47	0.987	6.577	845.4	112.7	1202300	939300
	85.00	25.00	0.889	6.479	817 8	109.0	1163000	908600
	80.00	**23.81**	**0.810**	**6.400**	**795.5**	**106.1**	**1131300**	**883900**
15	75.00	22.06	0.882	6.292	691.2	92.2	983000	768000
	70.00	20.59	0.784	6.194	663.6	88.5	943800	737400
	65.00	19.12	0.686	6.096	636.0	84.8	904600	706700
	60.00	**17.67**	**0.590**	**6.000**	**609.0**	**81.2**	**866100**	**676600**
15	55.00	16.18	0.656	5.746	511.0	68.1	726800	567800
	50.00	14.71	0.558	5.648	483.4	64.5	687500	537100
	45.00	13.24	0.460	5.550	455.8	60.8	648200	506400
	42.00	**12.48**	**0.410**	**5.500**	**441.7**	**58.9**	**628300**	**490800**
12	55.00	16.18	0.822	5.612	321.0	53.5	570600	445800
	50.00	14.71	0.699	5.489	303.3	50.6	539200	421300
	45.00	13.24	0.576	5.366	285.7	47.6	507900	396800
	40.00	**11.84**	**0.460**	**5.250**	**268.9**	**44.8**	**478100**	**373500**
12	35.00	10.29	0.436	5.086	228.3	38.0	405800	317000
	31.50	**9.26**	**0.350**	**5.000**	**215.8**	**36.0**	**383700**	**299700**
10	40.00	11.76	0.749	5.099	158.7	31.7	338500	264500
	35.00	10.29	0.602	4.952	146.4	29.3	312400	244100
	30.00	8.82	0.455	4.805	134.2	26.8	286300	223600
	25.00	**7.37**	**0.310**	**4.660**	**122.1**	**24.4**	**260500**	**203500**
9	35.00	10.29	0.732	4.772	111.8	24.8	265000	207000
	30.00	8.82	0.569	4.609	101.9	22.6	241500	188700
	25.00	7.35	0.406	4.446	91.9	20.4	217900	170800
	21.00	**6.31**	**0.290**	**4.330**	**84.9**	**18.9**	**201300**	**157300**
8	25.50	7.50	0.541	4.271	68.4	17.1	182500	142600
	23.00	6.76	0.449	4.179	64.5	16.1	172000	134400
	20.50	6.03	0.357	4.087	60.6	15.1	161600	126200
	18.00	**5.33**	**0.270**	**4.000**	**56.9**	**14.2**	**151700**	**118500**
7	20.00	5.88	0.458	3.868	42.2	12.1	128600	100400
	17.50	5.15	0.353	3.763	39.2	11.2	119400	93300
	15.00	**4.42**	**0.250**	**3.660**	**36.2**	**10.4**	**110400**	**86300**
6	17.25	5.07	0.475	3.575	26.2	8.7	93100	72800
	14.75	4.34	0.352	3.452	24.0	8.0	85300	66600
	12.25	**3.61**	**0.230**	**3.330**	**21.8**	**7.3**	**77500**	**60500**
5	14.75	4.34	0.504	3.294	15.2	6.1	64600	50500
	12.25	3.60	0.357	3.147	13.6	5.4	58100	45400
	9.75	**2.87**	**0.210**	**3.000**	**12.1**	**4.8**	**51600**	**40300**
4	10.50	3.09	0.410	2.880	7.1	3.6	38100	29800
	9.50	2.79	0.337	2.807	6.7	3.4	36000	28100
	8.50	2.50	0.263	2.733	6.4	3.2	33900	26500
	7.50	**2.21**	**0.190**	**2.660**	**6.0**	**3.0**	**31800**	**24900**
3	7.50	2.21	0.361	2.521	2.9	1.9	20700	16200
	6.50	1.91	0.263	2.423	2.7	1.8	19100	15000
	5.50	**1.63**	**0.170**	**2.330**	**2.5**	**1.7**	**17600**	**13800**

$$W = \frac{C \text{ or } C'}{L} \qquad M = \frac{C \text{ or } C'}{8} \qquad C \text{ or } C' = WL = 8M = \frac{8SZ}{12}$$

PROPERTIES OF CHANNELS

1 Depth of Channel Inches	2 Weight per Foot Pounds	3 Area of Section Square Inches	4 Thickness of Web Inches	5 Width of Flange Inches	6 Mom. of Inertia Neutral Axis Perpendicular to Web at Center I	7 Section Modulus Neutral Axis Perpendicular to Web at Center Z	8 Coefficient of Strength for Fiber Stress of 16,000 lbs. per sq. in. Used for Buildings C	9 Coefficient of Strength for Fiber Stress of 12,500 lbs. per sq. in. Used for Bridges C'
15	55.00	16.18	0.818	3.818	430.2	57.4	611900	478000
	50.00	14.71	0.720	3.720	402.7	53.7	572700	447400
	45.00	13.24	0.622	3.622	375.1	50.0	533500	416800
	40.00	11.76	0.524	3.524	347.5	46.3	494200	386100
	35.00	10.29	0.426	3.426	320.0	42.7	455000	355500
	33.00	**9.90**	**0.400**	**3.400**	**312.6**	**41.7**	**444500**	**347300**
12	40.00	11.76	0.758	3.418	197.0	32.8	350200	273600
	35.00	10.29	0.636	3.296	179.3	29.9	318800	249100
	30.00	8.82	0.513	3.173	161.7	26.9	287400	224500
	25.00	7.35	0.390	3.050	144.0	24.0	256100	200000
	20.50	**6.03**	**0.280**	**2.940**	**128.1**	**21.4**	**227800**	**178000**
10	35.00	10.29	0.823	3.183	115.5	23.1	246400	192500
	30.00	8.82	0.676	3.036	103.2	20.6	220300	172100
	25.00	7.35	0.529	2.889	91.0	18.2	194100	151700
	20.00	5.88	0.382	2.742	78.7	15.7	168000	131200
	15.00	**4.46**	**0.240**	**2.600**	**66.9**	**13.4**	**142700**	**111500**
9	25.00	7.35	0.615	2.815	70.7	15.7	167600	130900
	20.00	5.88	0.452	2.652	60.8	13.5	144100	112600
	15.00	4.41	0.288	2.488	50.9	11.3	120500	94200
	13.25	**3.89**	**0.230**	**2.430**	**47.3**	**10.5**	**112200**	**87600**
8	21.25	6.25	0.582	2.622	47.8	11.9	127400	99500
	18.75	5.51	0.490	2.530	43.8	11.0	116900	91300
	16.25	4.78	0.399	2.439	39.9	10.0	106400	83200
	13.75	4.04	0.307	2.347	36.0	9.0	96000	75000
	11.25	**3.35**	**0.220**	**2.260**	**32.3**	**8.1**	**86100**	**67300**
7	19.75	5.81	0.633	2.513	33.2	9.5	101100	79000
	17.25	5.07	0.528	2.408	30.2	8.6	92000	71800
	14.75	4.34	0.423	2.303	27.2	7.8	82800	64700
	12.25	3.60	0.318	2.198	24.2	6.9	73700	57500
	9.75	**2.85**	**0.210**	**2.090**	**21.1**	**6.0**	**66800**	**52200**
6	15.50	4.56	0.563	2.283	19.5	6.5	69500	54300
	13.00	3.82	0.440	2.160	17.3	5.8	61600	48100
	10.50	3.09	0.318	2.038	15.1	5.0	53800	42000
	8.00	**2.38**	**0.200**	**1.920**	**13.0**	**4.3**	**46200**	**36100**
5	11.50	3.38	0.477	2.037	10.4	4.2	44400	34700
	9.00	2.65	0.330	1.890	8.9	3.5	37900	29600
	6.50	**1.95**	**0.190**	**1.750**	**7.4**	**3.0**	**31600**	**24700**
4	7.25	2.13	0.325	1.725	4.6	2.3	24400	19000
	6.25	1.84	0.252	1.652	4.2	2.1	22300	17400
	5.25	**1.55**	**0.180**	**1.580**	**3.8**	**1.9**	**20200**	**15800**
3	6.00	1.76	0.362	1.602	2.1	1.4	14700	11500
	5.00	1.47	0.264	1.504	1.8	1.2	13100	10300
	4.00	**1.19**	**0.170**	**1.410**	**1.6**	**1.1**	**11600**	**9100**

$$W = \frac{C \text{ or } C'}{L} \qquad M = \frac{C \text{ or } C'}{8} \qquad C \text{ or } C' = WL = 8M = \frac{8SZ}{12}$$

W = Safe load in pounds uniformly distributed; L = Span in feet; M = Bending moment in foot pounds; S = Safe working stress; C and C' = Coefficients; Weights in heavy print are standard; others are special.

NOTE—The two tables give the properties of Carnegie Standards.

TYPICAL EXAMPLE

When the floor beams have been laid out to suit the requirements or location of the ground, the floor design may then be quickly and accurately arrived at by following the various steps as outlined below.

SLABS

The spans and loads being given, we will refer to the diagrams or curves of safe loads.

Three panels are to carry 250 pounds per square foot, uniformly distributed on ten and eleven foot spans:

On diagram of curves for slabs reenforced with Standard No. 22 du Mazuel reenforcement, we follow the safe live load vertical line marked 250 until we reach the clear span horizontal line marked 11, and find that a 2-inch slab is too small while a 2½-inch slab weighing 34.05 pounds per square foot would answer the purpose and is therefore chosen.

Two panels are to carry 400 pounds per square foot, uniformly distributed on 6-foot spans:

On diagram of curves for slabs reenforced with Standard No. 26 du Mazuel reenforcement, we find that a 2-inch slab would fully answer the purpose. However, as the top surface of a factory floor usually should be level, we will choose a similar slab of 2½ inches, weighing 32.51 pounds per square foot.

MAIN BEAMS

Main beams are those beams that do not directly carry the floor panels, but which support the secondary beams carrying these panels.

SECONDARY BEAMS

The loading on the secondary beams is uniform, and each beam carries half of its adjacent panel's live and dead loads.

RULE FOR SELECTING MAIN OR SECONDARY BEAMS

When selecting a member, whether for a main or a secondary beam, the first consideration should be standardization and lightness of weight. In other words it is preferable to choose a standard size and of the lightest weight: — a 24″ I @ 80 pounds per lineal foot of beam is preferable to a 20″ I @ 80 pounds where the greater depth is not objectionable; a 20″ I @ 65 pounds to a 15″ I @ 80 pounds, and so on.

BEAM "BD"

This beam, therefore, carries a load of 250 pounds plus 34.05 pounds by 18 feet by 5 feet.

$$W = 284.05 \times 18 \times 5 = 25{,}565 \text{ pounds;}$$

and the section modulus, from the table of general formulae.

(see page 66)

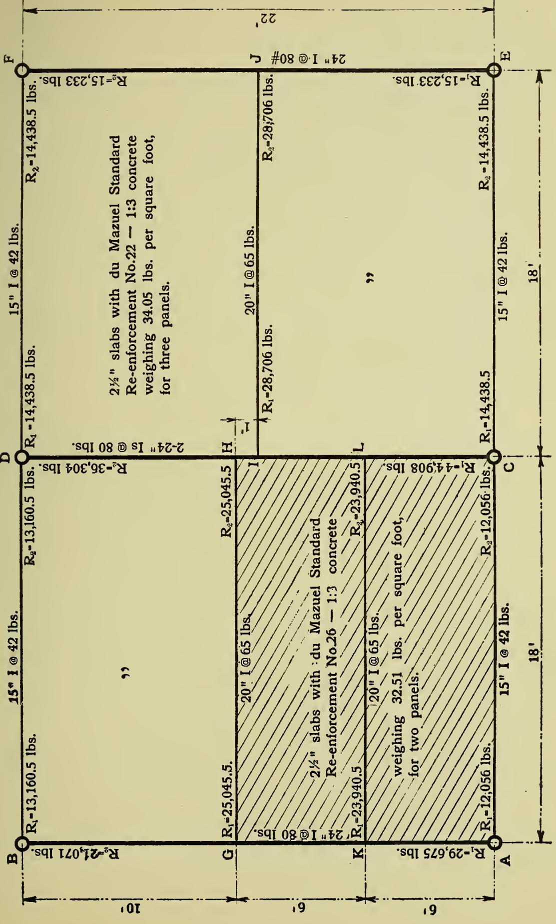
PLAN OF A FACTORY FLOOR

Shaded part to be loaded to 400 pounds per square foot, unshaded part to 250 pounds per square foot.

Columns or piers are shown by circles, main girders or beams by heavy lines, and secondary girders or beams by ordinary solid lines.

The safe working factor to be 14,000 pounds per square inch of steel.

EXAMPLE


22'
24" I @ 80#
F
E
D
C
B
A
G
H
I
J
K
L
15" I @ 42 lbs.
20" I @ 65 lbs.
2-24" Is @ 80 lbs.
24" I @ 80 lbs.
R₂=15,233 lbs.
R₁=15,233 lbs.
R₂=14,438.5 lbs.
R₁=14,438.5 lbs.
R₁=14,438.5
R₂=28,706 lbs.
R₁=28,706 lbs.
R₂=36,304 lbs.
R₂=13,160.5 lbs.
R₁=13,160.5 lbs.
R₂=21,071 lbs.
R₂=25,045.5
R₁=25,045.5.
R₂=23,940.5
R₁=23,940.5
R₁=14,908 lbs.
R₂=12,056 lbs.
R₁=12,056 lbs.
R₁=29,675 lbs.
2½" slabs with du Mazuel Standard Re-enforcement No.22 — 1:3 concrete weighing 34.05 lbs. per square foot, for three panels.
2½" slabs with du Mazuel Standard Re-enforcement No.26 — 1:3 concrete weighing 32.51 lbs. per square foot, for two panels.
"
1'
18'
18'
10'
6'
6'

will give

$$Z = \frac{3 \times 25,565 \times 18}{2 \times 14,000} = 49.30$$

Reference to column 7 of table of properties of I beams, shows that a 12″ I @ 50 pounds would be required. It will be found best, however, to choose a standard and therefore a 15″ I @ 42 pounds is selected.

R_1 and R_2 for this beam will be equal to half the load W plus half of the weight of the selected beam itself.

$$R_1 = R_2 = 12,782.5 + 378 = 13,160.5 \text{ pounds.}$$

BEAMS "DF" AND "CE"

These two beams are alike and carry the same loads, viz: 250 pounds plus 34.05 pounds by 18 feet by 5.5 feet.

$$W = 284.05 \times 18 \times 5.5 = 28,121 \text{ pounds}$$

$$Z = \frac{3 \times 28,121 \times 18}{2 \times 14,000} = 54.23$$

calling for 15″ I @ 42 pounds each.

$$R_1 = R_2 = 14,060.5 + 378 = 14,438.5 \text{ pounds.}$$

BEAM "IJ"

For this beam the loading is 250 pounds plus 34.05 pounds by 18 feet by 11 feet.

$$W = 284.05 \times 18 \times 11 = 56,242 \text{ pounds.}$$

$$Z = \frac{3 \times 56,242 \times 18}{2 \times 14,000} = 108.47$$

calling for a 20″ I @ 65 pounds.

$$R_1 = R_2 = 28{,}121 + 585 = 28{,}706 \text{ pounds.}$$

BEAM "GH"

This beam supports two half panels of unequal loading. One is 250 pounds plus 34.05 pounds by 18 feet by 5 feet, the other is 400 pounds plus 32.51 pounds by 18 feet by 3 feet.

$$\begin{aligned} 284.05 \times 18 \times 5 &= 25{,}565 \\ 432.51 \times 18 \times 3 &= \underline{23{,}356} \\ W \cdots\cdots\cdots\cdots &= 48{,}921 \text{ pounds.} \end{aligned}$$

$$Z = \frac{3 \times 48{,}921 \times 18}{2 \times 14{,}000} = 94.348$$

calls for a 15″ I @ 80 pounds, but it is better to choose a 20″ I @ 65 pounds.

$$R_1 = R_2 = 25{,}045.5 \text{ pounds.}$$

BEAM "KL"

The load here is 400 pounds plus 32.51 pounds by 18 feet by 6 feet.

$$W = 432.51 \times 18 \times 6 = 46{,}711 \text{ pounds.}$$

$$Z = \frac{3 \times 46{,}711 \times 18}{2 \times 14{,}000} = 90.086$$

calling for a 15″ I @ 80 pounds, but it is better to choose a 20″ I @ 65 pounds.

$$R_1 = R_2 = 23{,}940.5 \text{ pounds.}$$

BEAM "AC"

The load here is 400 pounds plus 32.51 pounds by 18 feet by 3 feet.

$$W = 432.51 \times 18 \times 3 = 23{,}356 \text{ pounds.}$$

$$Z = \frac{3 \times 23{,}356 \times 18}{2 \times 14{,}000} = 45.04$$

calling for a 15″ I @ 42 pounds.

$$R_1 = R_2 = 12{,}056 \text{ pounds.}$$

BEAM "AB"

This beam carries two reactions: R_1 of beam "K L", and R_1 of beam "GH" at points "K" and "G", 6 and 12 feet away from "A".

$$R_2 = \frac{(23{,}940.5 \times 6) + (25{,}045.5 \times 12)}{22} = 20{,}191 \text{ pounds,}$$

$$R_1 = 28{,}795 \text{ pounds.}$$

Maximum bending moment will be found to be:

$$m = (20{,}191 \times 10 \times 12) \text{ inch pounds.}$$

$$Z = \frac{20{,}191 \times 10 \times 12}{14{,}000} = 170.06$$

calling for a 24″ I @ 80 pounds.

And as all reactions include the beams:

$$R_1 = 29{,}675 \text{ pounds,}$$

$$R_2 = 21{,}071 \text{ pounds.}$$

BEAM "CD"

This beam carries three reactions: R_2 of beam "K L", R_1 of beam "IJ", and R_2 of beam "GH", at points

"L", "I", and "H", 6, 11 and 12 feet from "C".

$$R_2 = \frac{(23,940.5 \times 6) + (28,706 \times 11) + (25,045.5 \times 12)}{22} = 34,544 \text{ lbs.}$$

$$m = (34,544 \times 11 - 25,045.5 \times 1) \times 12 = 354,938.5 \times 12$$

$$Z = \frac{354,938.5 \times 12}{14,000} = 304.23$$

This section modulus is larger than that given by the biggest standard stock beam rolled, therefore it will have to be divided by two and the two beams corresponding to said arrived section moduli will be the beams chosen for "CD", one of these carrying as much as "AB", and the other as much as "EF", therefore two 24″ I beams @ 80 pounds will be selected.

This "CD" would then give as reactions the sum of similar reactions of "AB" and "EF", and including the weight of the beams as total reactions at "C" and "D".

$$R_1 = 44,908 \text{ pounds.}$$

$$R_2 = 36,304 \text{ pounds.}$$

BEAM "EF"

This beam carries only one reaction at center; and from the table of general formulae is had:

$$Z = \frac{3 \times 28,706 \times 22}{14,000} = 135.33$$

calling for a 20″ I @ 80 pounds, but we will make it a 24″ I @ 80 pounds.

Total reactions will include the beams:

$$R_1 = R_2 = 15,233 \text{ pounds.}$$

COLUMNS OR PIERS

Pier "A", as all others, has to be so designed as to safely support the reactions at that point, viz.: 41,731 pounds; pier "B" will therefore have to support safely 34,231.5 pounds; pier "C", 71,402.5 pounds; pier "D", 63,903.0 pounds; pier "E", 29,-671.5 pounds; and pier "F", 29,671.5 pounds.

FOUNDATIONS

Undoubtedly sound rock is the ideal foundation for structures. However, comparatively seldom does one find such a foundation in the locality where a building is to be erected, and one has to be satisfied by whatever ground there is at the spot, going deep enough to safeguard against frost, — that is one foot or more below the frost line.

As all earths do not sustain loads in the same proportion, the foundation has to be brought to a tapering or spreading base, as required, to cover enough ground and thereby allow it to sustain the loads to be piled above.

Below is a table of the sustaining powers of different earths.

BEARING POWER OF SOILS

Kind of material	Bearing power in tons per square foot	
	Min.	Max.
Rock—the hardest—in thick layers, in native bed	200	—
Rock equal to best ashlar masonry	25	30
Rock equal to best brick masonry	15	20
Rock equal to poor brick masonry	5	10
Clay on thick beds, always dry	4	6
Clay on thick beds, moderately dry	2	4
Clay, soft	1	2
Gravel and coarse sand, well cemented	8	10
Sand, compact and well cemented	4	6
Sand, clean, dry	2	4
Quicksand, alluvial soils, etc.	0.5	1

Hereunder are given examples of various pressures on different kinds of foundations for important work by eminent engineers.

PRESSURE ON FOUNDATIONS.

STRUCTURE.	SOIL.	TONS PER SQ. FOOT.
Cleveland Viaduct	Blue clay..	1·0 to 1·7
Busigny Bridge	Unstable sand	1·8
,, Arched Bridge ..	Yellow sandy clay..	2·1 to 2·8
Chimney, Newcastle ..	Compact clay	1·5
Kurtenberg Bridge .. .	Compact sand	2·3 to 2·9
Chimney, New York ..	Wet sand*	4·0
Viaduct, Pont de Jour .	Coarse gravel	4·4
Brooklyn Bridge ..	Sand	4·0
,, ,, ..	Compact stoney clay	5·5
Nantes Bridge	Sand*	6·78
Bordeaux Bridge	Compact sand and gravel ..	7·36 to 8·17
Washington Memorial ..	Clay and sand*	3 to 9*

* Settlement took place.

ARCHES

Many ways, graphical and theoretical, have been employed hitherto to design arches, but few of these ways, however, seem to be adaptable to all cases, and especially to concrete and reenforced concrete.

To cover reenforced concrete arches, therefore, it will be found advisable to combine both the graphical and theoretical.

As an arch may yield under the pressure to which it is subjected, either by the slipping of certain of its parts of contact upon one another, or by their turning over upon the theoretical edges of one another; and as these two conditions involve the whole question of its stability, the important point is to keep all of the forces within certain limits or bounds of said arch so as to prevent such slipping or overturning. These forces, commonly regarded as the line of pressure of an arch, should always be within the middle third of said arch ring so as to do away with all or most of the tension forces, and the arch ring from the crown or keystone to abutments should first of all be approximately established. This ring or *vousoir* would correspond to the thickness of a du Mazuel reenforced slab greatly increased.

All loads, live and dead, should be reduced to the same standard as that of the material of the arch itself, masonry or concrete, to one hundred and forty (140) pounds per cubic foot; and so as to simplify computations the arch should be considered to be a slice one foot in thickness, all other widths being a reproduction of the slice, thus all superficial measurements in the computations will represent cubic contents.

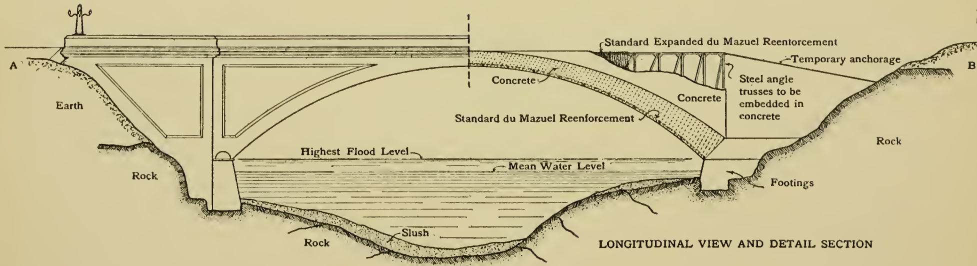
To avoid a long explanation of the subject an example is given and worked out, and if one follows it step by step, any arch, however complicated, can be readily and accurately computed.

EXAMPLE OF A du MAZUEL ARCH

The accompanying plate gives the design of an arch made of concrete reenforced by the du Mazuel system of reenforcement. This arch, which has to span clear one hundred and fifty (150) feet, is to be used as a country highway capable of sustaining a live and uniform load of six hundred (600) pounds per lineal foot and must be so designed as to resist the waters at their highest flood level.

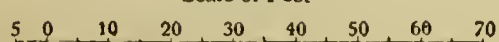
In choosing a location for the bridge, reference must be had to the ground upon which it is to stand, both as to the abutments on the banks of the river, and as to the piers which have to stand in the waterway. Piers should be avoided if possible, as it has been found dangerous to encroach upon the original width of rivers. Sound beds of primitive or of horizontally stratified rock, and well compact chalk, are unexceptional as substrata for bridge construction. Sound, hard, clayey gravel through which water will not rise if tried with a head equal to that which it may be subjected to in floods, forms an excellent base, and so do hard

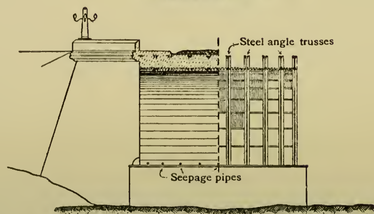
(see page 75)



LONGITUDINAL VIEW AND DETAIL SECTION

150 FOOT DU MAZUEL HIGHWAY BRIDGE
CAPACITY 600 LBS. PER SQ. FOOT
(1 TO 3 CONCRETE)





CENTER CROSS VIEW AND DETAIL SECTION

and not easily soluble or stiff clays, when in beds of considerable depth or thickness: but soft, soluble clays; loose, sandy gravel, and sand in any uncombined state, and subject to the action of the water, are not to be trusted. It must, too, be always borne in mind that the contraction of the waterway, which a bridge is almost certain to effect in a greater or less degree, tends to induce a more severe action upon the bed of the river than its substance can have been previously subjected to.

Of course, facility of approach to a bridge must not be overlooked in selecting a site upon which to build it, and it is essential to the desirability of a site that the approaches can be made direct and easy. The economical consideration must determine whether it is better to take up a more difficult position for the bridge, to obtain less expensive approaches, or to take up the best site for the bridge, and bestow whatever labor may be requisite to make suitable approaches for it.

Generally, however, in towns and cities, and for the most part throughout old settled countries and in commercial districts, bridges must be built where bridges are wanted, and a bridge must be adapted to its site.

The situation of the bridge being determined, a careful survey should be made of it and the proposed line or lines of approach, and of the river over which the bridge is to be built, for the whole length, at least, of the reach upon which it is to be placed. The results of the survey should be laid down as a map or plan presenting an ichnographic outline or representation upon a horizontal section of lines raised vertically from every point of the surface of the ground; for it must be obvious upon an inspection of the diagram, that a plan of the site from A to B, or from one side of the river to the other laid down from measurements made along the bending line of the surface, would give a much greater length than a plan upon a horizontal section of lines raised vertically from the surface of the ground to the straight and horizontal line AB. The plan required is such as this latter description indicates and as we have shown it. The irregularities of the ground must also be represented in diagrams such as the above, so that in arranging, designing, and estimating the intended work, the engineer may have the means before him of ascertaining the exact dimensions yielded by the site in every direction. Such a diagram as the above is termed a *section* and it should show, in addition to the irregularities of the ground, the various substances of which the ground is composed, and the thickness vertically of each substance as far as the object in view renders it necessary to ascertain — that is, until proper substance upon which to work has presented itself. This may be obtained by boring with augers made for the purpose.

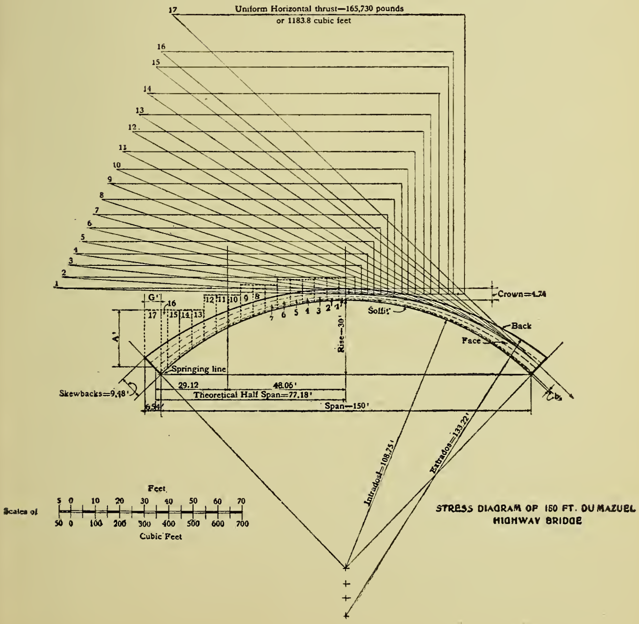
The abutments and abutment footings or piers are then carried to sound strata. The arch itself or *intrados* is laid out so as to give ample headway without raising the general highway level, and the springs of the arch are started above the highest flood level. The abutment footings, being most exposed to the currents of the water, are laid out of du Mazuel oleaginous concrete with a face smooth-trowel finished.

The abutments have been erected to the lines of theoretical haunches and thoroughly covered with heavy coats of asphaltum so as to allow for expansion, and the work is now ready for the arch erection proper. Before going further into the work, however, consider the general detail design of this arch.

The bridge considered without its spandrel filling, roadbed, railings, moldings, etc., etc., — that is, the arch proper, — the depth of which at crown has been defined by the following empirical formula:

$$\frac{\sqrt{\text{Radius} + \text{half span}}}{4} + 40\%$$

and the depth of skewbacks having been determined as double the depth of the crown, a most satisfactory rule for concrete arches, — is laid out to scale, and is



STRESS DIAGRAM OF 150 FT. DU MAZUEL HIGHWAY BRIDGE

Station	G'	A'	$A' \times G'$	$(A' \times G')_s$	H	M' or $A' \times G' \times H$	M'_s	$\frac{M'_s}{(A' \times G')_s}$
1	2.5	9.03	22.58	22.58	1.25	28.23	28.23	1.25
2	5	9.03	45.15	67.73	5.	225.75	253.98	3.75
3	5	9.5	47.5	115.23	10.	475.	728.78	6.33
4	5	9.5	47.5	162.73	15.	712.5	1441.28	8.86
5	5	10.	50.	212.73	20.	1000.	2441.28	11.48
6	5	11.	55.	267.73	25.	1375.	3816.28	14.26
7	5	10.5	52.5	320.23	30.	1575.	5391.28	16.84
8	5	12.	60.	380.23	35.	2100.	7491.28	19.7
9	5	13.5	67.5	447.73	40.	2700.	10191.28	22.76
10	5	11.5	57.5	505.23	45.	2587.5	12778.78	25.29
11	5	14.	70.	575.23	50.	3500.	16278.78	28.3
12	5	16.5	82.5	657.73	55.	4537.5	20816.28	31.65
13	5	14.	70.	727.73	60.	4200.	25016.28	34.38
14	5	17.5	87.5	815.23	65.	5687.5	30703.78	37.66
15	5	21.5	107.5	922.73	70.	7525.	38228.78	41.43
16	2.5	24.5	61.25	983.98	73.75	4517.19	42745.97	43.44
17	6.54	23.	150.42	1134.4	78.27	11773.37	54519.34	48.06

divided into any number of stations, the more the better, seventeen (17) being considered sufficient in this instance to demonstrate the theory. Over this arch are laid out imaginary strips of masonry equal to the six hundred (600) pounds per lineal foot, and in this case, equal to 4.29 at their smallest height.

Having prepared a table as shown here we then proceed to fill it in for each and every station.

Equating the moment around the theoretical span point, that is around the third of the skewback in conjunction to center of gravity of the considered part of the arch, we have for the present case 77.18 minus 48.06 from last column of above table, or a distance equal to 29.12 feet toward center of span, and get for the uniform horizontal pressure or thrust for each section, expressed in cubic feet of concrete

$$\frac{Y \times (A^1 \times G^1)_{17} \times b}{\text{Theoretical rise}}$$

$$\frac{29\ 12 \times 1{,}134.40 \times 1.16}{32.37} = 1{,}183.8$$

and expressed in pounds, 1,183.8 × 140 = 165,730 pounds, *b* being the distance in inches between the plane of apexes of upward forces in du Mazuel reenforcement to lower surface of arch or soffit — b should never exceed 1.1666 inches, or approximately mean depth of du Mazuel reenforcement, but should be chosen proportionately to the cross area of said reenforcement.

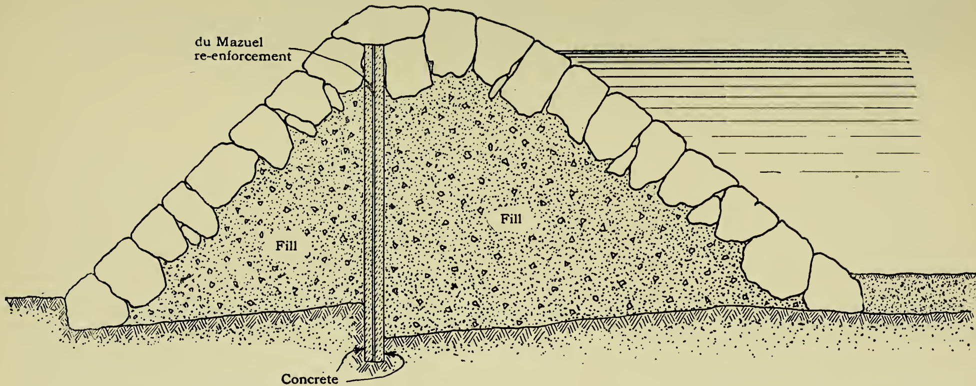
The line of pressure can now be readily plotted as follows:

Along a horizontal line passing through the theoretical rise point or through the center of the arch proper at the crown, and from the center on the line mark off the distances of the last column in table, 1.25, 3.75, 6.33, etc., etc., this being to same scale as arch. From ends of these distances draw perpendicular lines on which mark off to some convenient scale distances equal to amounts in the fourth column, 22.58, 67.73, 115.23, etc., etc., and, from these points draw the uniform or common horizontal thrust expressed in cubic feet to same convenient scale. From these last points are drawn the extended hypothenuses of the several triangles forming the pressure curve as shown. This curve should always be within the middle third of the arch proper.

The next steps are the laying of steel angle trusses, laying of reenforcement, laying of concrete for arch proper, embedding of the steel angle trusses in concrete, filling in of earth to proper grades, and then finishing the bridge to architectural lines.

SHEET PILING

In many cases the du Mazuel reenforcement made out of plain sheets may be used satisfactorily as a light, efficient sheet pile. Of course, in cases where boulders are present trouble would be experienced with the sheets crumpling, but in sandy, marshy soils, or in soft, wet ground, like mud, silt, swamp, quicksand, loam, or soft clay, where great difficulty is encountered in excavating, in keeping out water, in excluding the soft material from the excavation and in preventing the undermining of adjacent structures, the Standard No. 22 du Mazuel reenforcement will offer the only perfect interlocking, light, stiff, easily driven, waterproof *economical* sheet pile.



CROSS SECTION OF EARTH OR ROCK FILLED DAM WITH CORE WALL WATER-PROOFED AND RE-ENFORCED WITH DU MAZUEL RE-ENFORCEMENT.

HEATING SYSTEMS

Relative to heating a building, the engineer, architect or builder should invariably avoid the use of the hot air furnace. Indirect hot water is the ideal system. The cost of installation and maintenance, however, makes it generally prohibitory. Direct hot water is the practical, commercial way of warming the smaller buildings. The steam heating system commonly used for large buildings is preferable only in the case of indirect radiation.

The following rule for determining the size of radiation needed for a given room will be found to be very satisfactory:

Add the area of the glass surface in the room to one quarter of the exposed wall surface, and to this add from 1/55 to 3/55 of the cubical contents (1/55 for rooms on upper floors, 2/55 for rooms on lower floors and 3/55 for large halls); then for steam multiply by 0.35, and for hot water by 0.50.

EXAMPLE

An upper story room $20 \times 12 \times 10$ feet with glass exposure of 48 feet, ¼ of wall exposure (two sides exposed) 320 feet = 80, 1/55 of 2,400 = 44.

$$48 + 80 + 44 = 172 \times 0.35 = 60.20$$

60.20 feet is the radiation required for that room.

FIRE AND LOAD TESTS
of
DU MAZUEL REENFORCEMENTS
made at
TESTING STATION
OF THE CITY OF NEW YORK

IN compliance with the Building Code of New York, a fire, water and load test was made of the du Mazuel reenforcement. The du Mazuel reenforcement sheets were laid on top cords from girder to girder; the concrete being dumped and spread over them.

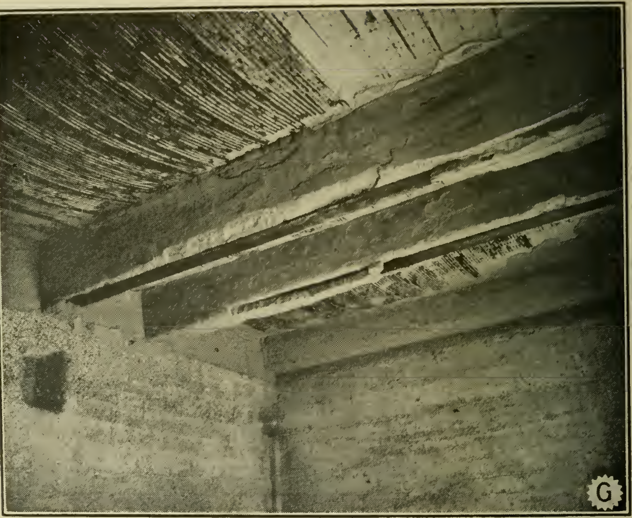
The under side was then plastered, forming a ceiling of three clear spans of 6 feet, 3½ feet and 9½ feet respectively, the 6 foot slab being 3½ inches in thickness and the considered section.

The entire building was constructed of concrete and provided with six chimneys and eight draft openings at the bottom, with two openings closed by doors for putting in the fuel.

A uniform load of 150 to 160 pounds per square foot was laid on top of the du Mazuel construction, and steel level rods were placed thereon for determining deflections.

An oak fire was started and kept up for four hours, so as to give a uniform heat throughout that time of from 1,750 to 1,860 degrees Fahrenheit.

At the end of the four hours, the New York City Fire Department came with hose and fire engine, and directed a 1 ¼ inch stream of water, having the tremendous force of between 60 and 80 pounds per square inch against the top and bottom of the du Mazuel construction, which had reached a white heat.



The next day, when the whole building had cooled, it was noticed that although the ceiling plastering under the du Mazuel construction had been injured

the beams were in a worse condition, the concrete around them having cracked, broken and fallen in many places. These beams were of the standard kind as used in most first-class, fireproof buildings.

Additional piles of pig iron were then heaped upon the du Mazuel construction, subjecting it to a stress, as required by the Building Code, of 600 to 650 pounds per square foot, uniformly distributed. Although a great part of the plastering had been burned out, or washed out by the high pressure stream of water, the deflection was then only a trifle over 2½ inches, and when this great load was removed the permanent deflection was only $2\frac{3}{16}$ inches, showing that the loads had scarcely any effect whatever.

PERMITS

As a result of the fire, water and load tests shown and explained on preceding pages, the Bureaus of Buildings of the various Boroughs of the City of New York, granted general permits or approval of the du Mazuel reenforcements, for general use in fireproof or other buildings within the City of New York.

TABLES, ETC.

WEIGHT OF A CUBIC FOOT OF SUBSTANCES

Aluminum	162
Anthracite, solid, of Pennsylvania	93
" broken, loose	54
" " moderately shaken	58
" heaped bushel, loose	(80)
Ash, American, white, dry	38
Asphaltum	87
Brass (Copper and Zinc), cast	504
" rolled	524
Brick, best pressed	150
" common, hard	125
" soft, inferior	100
Brickwork, pressed brick	140
" ordinary	112
Cement, hydraulic, ground, loose, American Rosendale	56
" " " " " Louisville	50
" " " " English, Portland	90
Cherry, dry	42
Chestnut, dry	41
Clay, potters', dry	119
" in lump, loose	63
Coal, bituminous, solid	84
" " broken, loose	49
" " heaped bushel, loose	(74)
Coke, loose, of good coal	26.3
" " heaped bushel	(40)
Copper, cast	542
" rolled	548
Earth, common loam, dry, loose	76
" " " " moderately rammed	95
" as a soft flowing mud	108
Ebony, dry	76
Elm, dry	35
Flint	162

WEIGHT OF A CUBIC FOOT OF SUBSTANCES

Continued

Glass, common window	157
Gneiss, common	168
Gold, cast, pure, or 24 carat	1204
" pure, hammered	1217
Grain, at 60 lbs. per bushel	48
Granite	170
Gravel, about the same as sand, which see.	
Gypsum (plaster of paris)	142
Hemlock, dry	25
Hickory, dry	53
Hornblende, black	203
Ice	58.7
Iron, cast	450
" wrought, purest	485
" " average	480
Ivory	114
Lead	711
Lignum Vitæ, dry	83
Lime, quick, ground, loose, or in small lumps	53
" " " " thoroughly shaken	75
" " " " per struck bushel	(66)
Limestones and marbles	168
" " loose, in irregular fragments	96
Magnesium	109
Mahogany, Spanish, dry	53
" Honduras, dry	35
Maple, dry	49
Marbles, see Limestones.	
Masonry, of granite or limestone, well dressed	165
" " mortar rubble	154
" " dry " (well scabbled)	138
" " sandstone, well dressed	144
Mercury, at 32° Fahrenheit	849
Mica	183
Mortar, hardened	103
Mud, dry, close	80 to 110
Mud, wet, fluid, maximum	120
Oak, live, dry	59

WEIGHT OF A CUBIC FOOT OF SUBSTANCES

Continued

Oak, white, dry	50
" other kinds	32 to 45
Petroleum	55
Pine, white, dry	25
" yellow, Northern	34
" " Southern	45
Platinum	1342
Quartz, common, pure	165
Rosin	69
Salt, coarse, Syracuse, N. Y.	45
" Liverpool, fine, for table use	49
Sand, of pure quartz, dry, loose	90 to 106
" well shaken	99 to 117
" perfectly wet	120 to 140
Sandstones, fit for building	151
Shales, red or black	162
Silver	655
Slate	175
Snow, freshly fallen	5 to 12
" moistened and compacted by rain	15 to 50
Spruce, dry	25
Steel	490
Sulphur	125
Sycamore, dry	37
Tar	62
Tin, cast	459
Turf or Peat, dry, unpressed	20 to 30
Walnut, black, dry	38
Water, pure rain or distilled, at 60° Fahrenheit	62⅓
" sea	64
Wax, bees	60.5
Zinc or Spelter	437.5

Green timbers usually weigh from one-fifth to one-half more than dry.

All loads are expressed in pounds.

UNITED STATES STANDARD GAUGE FOR SHEET AND PLATE IRON AND STEEL

Adopted as Standard by American Railway Master Mechanics Association and Association of American Steel Manufacturers

Number of Gauge	Approximate Thickness in Fractions of an Inch	Approximate Thickness in Decimal Parts of an Inch	Approximate Thickness in Millimeters	Weight per Square Foot in Pounds Avoirdupois, Iron	Weight per Square Foot in Pounds Avoirdupois, Steel	Weight per Square Meter in Kilogrammes Steel	Number of Gauge
0000000	1—2	.5	12.70	20.	20.4	99.601	0000000
000000	15—32	.46875	11.91	18.75	19.125	93.376	000000
00000	7—16	.4375	11.11	17.50	17.85	87.151	00000
0000	13—32	.40625	10.32	16.25	16.575	80.926	0000
000	3—8	.375	9.53	15.	15.3	74.701	000
00	11—32	.34375	8.73	13.75	14.025	68.476	00
0	5—16	.3125	7.94	12.50	12.75	62.251	0
1	9—32	.28125	7.14	11.25	11.475	56.026	1
2	17—64	.265625	6.75	10.625	10.8375	52.913	2
3	1—4	.25	6.35	10.	10.2	49.800	3
4	15—64	.234375	5.95	9.375	9.5625	46.688	4
5	7—32	.21875	5.56	8.75	8.925	43.575	5
6	13—64	.203125	5.16	8.125	8.2875	40.463	6
7	3—16	.1875	4.76	7.5	7.65	37.350	7
8	11—64	.171875	4.37	6.875	7.0125	34.238	8
9	5—32	.15625	3.97	6.25	6.375	31.125	9
10	9—64	.140625	3.57	5.625	5.7375	28.013	10
11	1—8	.125	3.18	5.	5.1	24.900	11
12	7—64	.109375	2.78	4.375	4.4625	21.788	12
13	3—32	.09375	2.38	3.75	3.825	18.675	13
14	5—64	.078125	1.98	3.125	3.1875	15.563	14
15	9—128	.0703125	1.79	2.8125	2.86875	14.006	15
16	1—16	.0625	1.59	2.5	2.55	12.450	16
17	9—160	.05625	1.43	2.25	2.295	11.205	17
18	1—20	.05	1.27	2.	2.04	9.960	18
19	7—160	.04375	1.11	1.75	1.785	8.715	19
20	3—80	.0375	0.953	1.50	1.53	7.470	20
21	11—320	.034375	0.873	1.375	1.4025	6.848	21
22	1—32	.03125	0.794	1.25	1.275	6.225	22
23	9—320	.028125	0.714	1.125	1.1475	5.603	23
24	1—40	.025	0.635	1.	1.02	4.980	24
25	7—320	.021875	0.556	.875	.8925	4.358	25
26	3—160	.01875	0.476	.75	.765	3.735	26
27	11—640	.0171875	0.437	.6875	.70125	3.424	27
28	1—64	.015625	0.397	.625	.6375	3.113	28
29	9—640	.0140625	0.357	.5625	.57375	2.801	29
30	1—80	.0125	0.318	.5	.51	2.490	30
31	7—640	.0109375	0.278	.4375	.44625	2.179	31
32	13—1280	.01015625	0.258	.40625	.414375	2.023	32
33	3—320	.009375	0.238	.375	.3825	1.868	33
34	11—1280	.00859375	0.218	.34375	.350625	1.712	34
35	5—640	.0078125	0.198	.3125	.31875	1.556	35
36	9—1280	.00703125	0.179	.28125	.286875	1.401	36
37	17—2560	.006640625	0.169	.265625	.2709375	1.323	37
38	1—160	.00625	0.159	.25	.255	1.245	38

PHYSICAL PROPERTIES OF METALS

FROM "AN INTRODUCTION TO METALLURGY," BY PROF. W. C. ROBERTS-AUSTEN, C.B., F.R.S.

Associate of the Royal School of Mines, Chemist and Assayer of the Royal Mint

	Symbol	Atomic Weight	Atomic Volume	Specific Gravity	Specific Heat	Melting Point	Co-efficient of Linear Expansion	Thermal Conductivity	Electrical Conductivity
						C.		Ag.=100.	Hg.at 0°=1
Aluminum	**Al.**	**27.00**	**10.6**	**2.56**	{0.2120† 0.2185*	{625† 654*	**0.0000231**	**31.33**	**35.29**
Antimony	Sb.	120.00	17.9	6.71	0.051	{440† 630*	0.0000105	4.03	2.053
Arsenic	As.	74.90	13.2	5.67	0.081	—	0.0000055	—	2.679
Barium	Ba.	136.86	36.5	3.75	0.047	1200			
Bismuth	Bi.	207.50	21.1	9.80	0.031	268	0.0000162	1.8	0.800
Cadmium	Cd.	111.70	12.9	8.60	0.057	320	0.0000306	20.06	13.95
Cæsium	Cs.	132.70	70.6	1.88	—	26			
Calcium	Ca.	39.91	25.4	1.57	0.170	Red heat.	—	—	12.46
Cerium	Ce.	141.00	21.0	6.68	0.045	{Between Sb. & Ag.			
Chromium	Cr.	52.40	7.7	6.80	(0.120)	{higher than Pt.			
Cobalt	Co.	58.60	6.9	8.50	0.110	1500	0.0000123	—	9.685
Copper	Cu.	63.20	7.2	8.82	0.094	{1080* 1050†	0.0000167	73.6	55.86
Didymium	Di.	145.00	22.3	6.54	0.046				
Glucinum	Gl.	9.08	5.6	2.07	0.580				
Gold	Au	196.20	10.2	19.32	0.032	{1045† 1062*	0.0000144	53.2	43.84
Indium	In.	113.40	15.3	7.42	0.057	176	0.0000417		
Iridium	Ir.	192.50	8.6	22.42	0.033	2500	0.0000070		
Iron	Fe.	55.90	7.2	7.86	0.110	1600	0.0000121	11.9	8.341
Lanthanum	La.	138.50	22.3	6.20	0.045				
Lead	Pb.	206.40	18.1	11.37	0.031	325	0.0000292	8.5	4.818
Lithium	Li.	7.01	11.9	0.59	0.941	180	—	—	10.69

‡ Authority—Landolt and Bornstein † Roberts-Austen * Haycock and Neville

PHYSICAL PROPERTIES OF METALS—Continued

	Symbol	Atomic Weight	Atomic Volume	Specific Gravity	Specific Heat	Melting Point	Co-efficient of Linear Expansion	Thermal Conductivity	Electrical Conductivity
						C.		Ag.=100.	Hg.at 0°=1
Magnesium	Mg.	23.94	13.8	1.74	0.250	750† / 633*	0.0000269	34.3	22.57
Manganese	Mn.	54.80	6.9	8.00	0.120	1900			
Mercury	Hg.	199.80	14.7	13.59	0.032	—39	—	1.3	1.000
Molybdenum	Mo.	95.90	11.1	8.60	0.072				
Nickel	Ni.	58.60	6.7	8.80	0.110	1600	0.0000127	—	7.374
Niobium	Nb.	94.00	15.0	6.27	?				
Osmium	Os.	195.00	8.7	22.48	0.031	2500	0.0000065		
Palladium	Pd.	106.20	9.2	11.50	0.059	1500	0.0000117	—	6.910
Platinum	Pt.	194.30	9.1	21.50	0.033	1775	0.0000089	8.4	8.257
Potassium	K.	39.03	45.4	0.87	0.170	62	0.0000841	—	11.23
Rhodium	Rh.	104.10	8.6	12.10	0.058	2000	0.0000085		
Rubidium	Rb.	85.20	56.1	1.52	0.077	38			
Ruthenium	Ru.	103.50	8.4	12.26	0.061	1800	0.0000096		
Silver	Ag.	107.66	10.2	10.53	0.056	945† / 961*	0.0000192	100.0	57.226
Sodium	Na.	22.99	23.7	0.97	0.290	95	0.0000710	36.5	18.30
Strontium	Sr.	87.20	34.9	2.54	0.074	—	—	—	3.774
Tantalum	Ta.	182.00	16.9	10.80	?				
Tellurium	Te.	126.30	20.2	6.25	0.047	525	0.0000167	—	0.0004
Thallium	Tl.	203.70	17.1	11.85	0.034	288	0.0000302	—	5.225
Thorium	Th.	232.00	20.9	11.10	0.028				
Tin	Sn.	117.40	16.1	7.29	0.056	227† / 232*	0.0000223	15.2	8.237
Titanium	Ti.	48.00	—	—	0.130?				
Tungsten	W.	184.00	9.6	19.10	0.033	higher than Mn			
Uranium	U.	240.00	12.8	18.70	9.028				
Vanadium	V.	51.10	9.3	5.50	?	1775			
Zinc	Zn.	64.90	9.1	7.15	0.094	415† / 420*	0.0000291	28.1	16.92
Zirconium	Zr.	90.40	21.7	4.15	0.066				

† Roberts-Austen

* Haycock and Neville

Dr. du Mazuel's Logarithms of numbers to 100, of primes under 1100 and of certain other numbers, to sixty-one places.
For ordinary calculations take only first few places.

N.	Logarithms	N.
1	0.00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,000000	1
2	0.30102,99956,63981,19521,37388,94724,49302,67681,89881,46210,85413,104275	2
3	0.47712,12547,19662,43729,50279,03255,11530,92001,28864,19069,58648,298656	3
4	0.60205,99913,27962,39042,74777,89448,98605,35363,79762,92421,70826,208549	4
5	0.69897,00043,36018,80478,62611,05275,50697,32318,10118,53789,14586,895725	5
6	0.77815,12503,83643,63250,87667,97979,60833,59683,18745,65280,44061,402931	6
7	0.84509,80400,14256,83071,22162,58592,63619,34835,72396,32396,54065,036350	7
8	0.90308,99869,91943,58564,12166,84173,47908,03045,69644,38632,56239,312824	8
9	0.95424,25094,39324,87459,00558,06510,23061,84002,57728,38139,17296,597313	9
10	1.00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,00000,000000	10
11	1.04139,26851,58225,04075,01999,71243,02424,17067,02190,46645,30945,965390	11
12	1.07918,12460,47624,82772,25056,92704,10136,27365,08627,11491,29474,507206	12
13	1.11394,33523,06836,76920,65051,57942,32843,08297,29188,38706,82718,011910	13
14	1.14612,80356,78238,02592,59551,53317,12922,02517,62277,78607,39478,140624	14
15	1.17609,12590,55681,24208,12890,08530,62228,24319,58982,72858,73235,194382	15
16	1.20411,99826,55924,78085,49555,78897,97210,70727 59525,84843,41652,417098	16
17	1.23044,89213,78273,92854,01698,94328,33703,00075,67378,42504,63973 803685	17
18	1.25527,25051,03306,06980,37947,01234,72364,51684 47609,84350,02709,701587	18
19	1.27875,36009,52828,96153,63334,75756,92931,79511,29337,39449,75989,068189	19
20	1.30102,99956,63981,19521,37388,94724,49302,67681,89881,46210,85413,104275	20
21	1.32221,92947,33919,26800,72441,61847,75150,26837,01260,51466,12713,335006	21
22	1.34242,26808,22206,23596,39388,65967,51726,84748,92071,92856,16359,069665	22
23	1.36172,78360,17592,87886,77771,12251,18954,96975,11034,33609,61882,756055	23
24	1.38021,12417,11606,02293,62445,87428,59438,95046,98508,57702,14887,611480	24
25	1.39794,00086,72037,60957,25222,10551,01394,64636,20237,07578,29173,791451	25
26	1.41497,33479,70817,96442,02440,52666,82145,75979,19069,84917,68131,116184	26
27	1.43136,37641,58987,31188,50837,09765,34592,76003,86592,57208,75944,895969	27
28	1.44715,80313,42219,22113,96940,48041,62224,70199,52159,24818,24891,244899	28
29	1.46239,79978,98956,08733,28467,62969,25499,12542,94417,88715,38410,653969	29
30	1.47712,12547,19662,43729,50279,03255,11530,92001,28864,19069,58648,298656	30
31	1.49136,16938,34272,67966,67041,00118,41572,23037,01558,30418,46559,383498	31
32	1.50514,99783,19905,97606,86944,73622,46513,38409,49407,31054,27065,521373	32
33	1.51851,39398,77887,47804,52278,74498,13955,09068,31054,65714,89594,264047	33
34	1.53147,89170,42255,12375,39087,89052,83005,67757,57259,88715,49386,907959	34
35	1.54406,80443,50275,63549,84773,63868,14316,67153,82514,86185,68651,932075	35
36	1.55630,25007,67287,26501,75335,95959,21667,19366,37491,30560,88122,805862	36
37	1.56820,17240,66994,99680,84506,89539,12944,79829,72690,16631,25466,176799	37
38	1.57978,35966,16810,15675,00723,70481,42234,47193,19218,85660,61402,172463	38
39	1.59106,46070,26499,20650,15330,61197,44374,00298,58052,57776,41366,310566	39
40	1.60205,99913,27962,39042,74777,89448,98605,35363,79762,92421,70826,208549	40
41	1.61278,38567,19735,49450,94118,49968,18079,95305,13633,83368,70890,073567	41
42	1.62324,92903,97900,46322,09830,56572,24452,94518,91141,97676,98126,439281	42
43	1.63346,84555,79586,52640,50881,53229,22215,88087,74884,38009,34145,247493	43
44	1.64345,26764,86187,43117,76777,60692,01029,52430,81953,39067,01772,173939	44
45	1.65321,25137,75343,67937,63169,11785,73759,16320,67846,91928,31883,493038	45
46	1.66275,78316,81574,07408,15160,06975,68257,64657,00915,79820,47295,860329	46
47	1.67209,78579,35717,46441,42193,99449,20064,01598,03098,42994,78270,373294	47
48	1.68124,12373,75587,21814,99834,82153,08741,62728,88390,03913,00300,715755	48
49	1.69019,60800,28513,66142,44325,17185,27238,69671,44792,64793,08130,072699	49
50	1.69897,00043,36018,80478,62611,05275,50697,32318,10118,53789,14586,895725	50
51	1.70757,01760,97936,36583,51977,97583,45233,92076,96242,61574,22622,102341	51
52	1.71600,33436,34799,15963,39829,47391,31448,43661,08951,31128,53544,220459	52
53	1.72427,58696,00789,04563,29922,91627,25659,26955,02401,29493,77805,941030	53
54	1.73239,37598,22968,50709,88226,04489,83895 43685,76474,03419,61358,000244	54
55	1.74036,26894,94243,84553,64610,76518,53121,49385,12309,00434,45532,861116	55
56	1.74818,80270,06200,41635,34329,42766,11527,37881,42040,71029,10304,349173	56
57	1.75587,48556,72491,39883,13613,79012,04462,71512,58201,58519,34637,366845	57
58	1.76342,79935,62937,28254,65856,57693,74801,80224,84299,34926,23823,758244	58
59	1.77085,20116,42144,19026,06563,84535,14423,89267,44474,93076,52155,272857	59
60	1.77815,12503,83643,63250,87667,97979,60833,59683,18745,65280,44061,402931	60

61	1.78532,98350,10767,03388,57485,13757,32134.92633,78757,11340,42120,703489	61
62	1.79239,16894,98253,87488,04429,94842,90874,90718,91439,76629,31972,487773	62
63	1.79934,05494,53581,70530,22720,65102,86681,18838,30124,70535,71361,633662	63
64	1.80617,99739,83887,17128,24333,68346,95816,06091,39288,77265,12478,625648	64
65	1.81291,33566,42855,57399,27662,63217,83540,40615,39306,92495,97304,907635	65
66	1.81954,39355,41868,67325,89667,69222,63257,76750,20936,11925,75007,368321	66
67	1.82607,48027,00826,43414,91316,29226,06858,09496,26080,56861,38691,179160	67
68	1.83250,89127,06236,31896,76476,83777,32308,35439,47141,34926,34800,012234	68
69	1.83884,90907,37255,31616,28050,15506,30485,88976,39898,52679,20531,054711	69
70	1.84509,80400,14256,83071,22162,58592,63619,34835,72396,32396,54065,036350	70
71	1.85125,83487,19075,28609,28294,35035,42913,52704,19901,60039,19762,766499	71
72	1.85733,24964,31268,46023,12724,90683,70969,87048,27372,76771,73535,910137	72
73	1.86332,28601,20455,90107,43869,00470,30853,44528,68255,31165,74851,100020	73
74	1.86923,17197,30976,19202,21895,84263,62247,47511,62571,62842,10879,281074	74
75	1.87506,12633,91700,04686,75501,13806,12925,56637,49101,26647,87822,090107	75
76	1.88081,35922,80791,35196,38112,65205,91537,14875,09100,31871,46815,276738	76
77	1.88649,07251,72481,87146,24162,29835,66043,51902,74586,79041,85011,001740	77
78	1.89209,46026,90480,40171,52719,55921,93676,67980,47934,03987,26779,414841	78
79	1.89762,70912,90441,42799,48213,86478,24968,64828,62019,02515,03156,163513	79
80	1.90308,99869,91943,58564,12166,84173,47908,03045,69644,38632,56239,312824	80
81	1.90848,50188,78649,74918,01116,13020,46123,68005,15456,76278,34593,194626	81
82	1.91381,38523,83716,68972,31507,44692,67382,62987,03515,29579,56303,177842	82
83	1.91907,80923,76073,90383,27603,52027,26124,70016,37658,08063,04535,293708	83
84	1.92427,92860,61881,65843,47219,51296,73755,62200,81023,43887,83539,543555	84
85	1.92941,89257,14292,73332,64309,99603,84400,32393,77496,96293,78560,699410	85
86	1.93449,84512,43567,72161,88270,47953,71518,55769,64765,84220,19558,351768	86
87	1.93951,92526,18618,52462,78746,66224,37030,04544,23282,07784,97058,952625	87
88	1.94448,26721,50168,62639,14166,55416,50332,20112,71834,85277,87185,278214	88
89	1.94939,00066,44912,78472,35433,69702,44112,46651,61858,10024,45836,328694	89
90	1.95424,25094,39324,87459,00558,06510,23061,84002,57728,38139,17296,597313	90
91	1.95904,13923,21093,59991,87214,16534,96462,43133,01584,71103,36783,048259	91
92	1.96378,78273,45555,26929,52549,01700,17560,32338,90797,26031,32708,964604	92
93	1.96848,29485,53935,11696,17320,03373,53103,15038,30422,49488,05267,682155	93
94	1.97312,78535,90698,65962,79582,94173,69366,69279,92979,89205,63683,477569	94
95	1.97772,36052,88847,76632,25945,81032,43629,11829,39455,93238,90575,963914	95
96	1.98227,12330,39568,41336,37223,76877,58044,30410,78271,50123,85713,820029	96
97	1.98677,17342,66244,85178,43618,11665,57744,94258,41584,63886,69747,187207	97
98	1.99122,60756,92494,85663,81714,11909,76541,37353,34674,11003,93543,176974	98
99	1.99563,51945,97549,91534,02557,77753,25486,01069,59918,84784,48242,562703	99
101	2.00432,13737,82642,57427,51881,78222,93791,32192,89355,20645,25914,058186	101
103	2.01283,72247,05172,20517,10711,94580,23942,43905,23496,97603,05647,528079	103
107	2.02938,37776,85209,64083,45412,39461,43564,61268,16891,63401,93519,816620	107
109	2.03742,64979,40623,63520,05133,07613,87528,66422,04522,82798,36821,104005	109
113	2.05307,84434,83419,72279,52270,28609,44818,47783,83623,62209,75395,157054	113
127	2.10380,37209,55956,86424,69874,21827,28625,85765,63239,79239,38677,687822	127
131	2.11727,12956,55764,26081,00542,70697,73859,47801,63117,12162,69689,770335	131
137	2.13672,05671,56406,76856,29266,27114,78973,36782,29707,46423,50456,632444	137
139	2.14301,48002,54095,08045,64332,02319,84731,44797,32967,91785,93396,574308	139
149	2.17318,62684,12274,03825,73635,42628,33705,39346,71326,37222,11012,048653	149
151	2.17897,69472,93169,43686,90730,55337,30278,84460,93428,77687,74510,971401	151
157	2.19589,96524,09233,73676,14811,29897,28370,50651,90992,78552,95873,594477	157
163	2.21218,76044,03957,80764,00914,35925,99475,49930,97247,35985,06185,303704	163
167	2.22271,64711,47583,27998,40759,09920,46753,44613,38401,33125,82289,069635	167
173	2.23804,61031,28795,41456,05302,58758,46588,77816,83269,13492,66453,988743	173
179	2.25285,30309,79893,16957,03826,91773,05861,94310,72090.67852,86239,477285	179
181	2.25767,85748,69184,51028,97436,76412,29249,22479,59232,72291,88769,574799	181
191	2.28103,33672,47727,53763,50435,98270,61031,84957,36134,17824,30405,891262	191
193	2.28555,73090,07773,76059,72386,46353,31082,10979,21601,94604,88412,889733	193
197	2.29446,62261,61592,92737,17443,17717,15501,75120,64672,00453,36906,180720	197
199	2.29885,30764,09706,65010,00217,84419,80284,14948,88771,49827,32431,907065	199
211	2.32428,24552,97692,66508,15581,29927,88565,15502,58502,90193,86869,014730	211
223	2.34830,48630,48160,67347,51762,16240,35234,44534,24237,98021,08177,231582	223
227	2.35602,58571,93122,72010,30489,64753,67294,74838,78261,56058,48416,494656	227
229	2.35983,54823,39887,99412,79298,65526,65887,03358,93242,54328,14002,593934	229
233	2.36735,59210,26018,97218,91388,35476,85936,08884,54098,32289,45750,381402	233
239	2.37839,79009,48137,68500,16611,60147,89212,27092,22421,69429,85262,599734	239

241	2.38201,70425,74868,38407,68839,66454,63294,43845,75422,87941,37116,090780	241
251	2.39967,37214,81038,13934,05493,16706,90408,18574,66685,39315,23086,557977	251
257	2.40993,31233,31294,53716,28954,65919,63183,09299,89891,62261,22190,657085	257
263	2.41995,57484,89757,86897,22335,83870,11811,42207,55733,87652,55581,847682	263
269	2.42975,22800,02407,98008,72285,15871,27175,37709,54680,10337,16358,202492	269
271	2.43296,92908,74405,72952,11801,94875,18026,90280,28099,71147,47196,959683	271
277	2.44247,97690,64448,55377,77563,19599,75831,09223,84739,72572,00838,275546	277
281	2.44870,63199,05079,89286,39179,16275,08871,55000,84994,87733,11091,225526	281
283	2.45178,64355,24290,23555,89519,10570,23772,98828,25398,13326,05411,834686	283
293	2.46686,76203,54109,45624,37585,12602,18133,14970.80293,87633,91801,387293	293
307	2.48713,83754,77186,48475,46084,36539,33504,93281,89817,26663,11352,567959	307
311	2.49276,03890,26837,50555,30231,83253,64155,85949,18519,90441,42367,782324	311
313	2.49554,43375,46448,48480,81265,04861,24315,15792,98693,98571,52993,196813	313
317	2.50105,92622,17751,49455,32290,16378,22488,04877,22158,71549,07278,111979	317
331	2.51982,79937,75718,73860,81406,07340,85663,50827,13549,69614,46087,295510	331
337	2.52762,99008,71338,62619,00147,90194,51019,87041,58106,86338,94145,590771	337
347	2.54032,94747,90873,71853,53573,03206,97397,86865,56176,91243,65052,250367	347
349	2.54282,54269,59179,89654,01719,77159,63066,31783,00866,75487,94181,990296	349
353	2.54777,47053,87822,56549,70693,15968,56119,79362,71500,87393,47356,171765	353
359	2.55509,44485,78319,14781,65293,94413,89970,02357,64461,12862,45018,194841	359
367	2.56466,60642,52089,33798,75290,93006,90914,75947,52157,57773,73388,529180	367
373	2.57170,88318,08687,60550,68969,38701,43991,49308,33032,45651,82236,828475	373
379	2.57863,92099,68072,34193,14620,59454,44405,29413,87210,96923,21381,081258	379
383	2.58319,87739,68622,74037,90461,29502,11234,47857,39787,51936,81090,658346	383
389	2.58994,96013,25707,73624,49469,11731,95270,14076,41221,24688,95645,064384	389
397	2.59879,05067,63115,06587,68482,40668,63112,25522,37562,91876,18078,588386	397
401	2.60314,43726,20182,30654,46411,48149,42549,75189,88963,37359,82761,562011	401
409	2.61172,33080,07341,80360,95027,17736,46679,00320,51595,65255,67279,407052	409
419	2.62221,40229,66295,30985,07395,99373,73621,25514,08166,99180,26223,814797	419
421	2.62428,20958,35668,30744,40669,23421,44371,09437,88488,01681,56998,058298	421
431	2.63447,72701,60731,60075,02803,26184,67878,49873,63233,16232,39160,168424	431
433	2.63648,78963,53365,44269,80664,49685,26766,08604,17833,53839,54652,633209	433
439	2.64246,45202,42121,37063,37411,50613,31363,46233,64482,93197,78492,698498	439
443	2.64640,37262,23069,56023,01044,89684,43902,83230,69450,39547,31960,218878	443
449	2.65224,63410,03323,17491,90263,53743,43105,35027,59942,01108,72112,409383	449
457	2.65991,62000,69850,22235,35461,45220,47714,05940,16155,52489,85626,587883	457
461	2.66370,09253,89648,14507,46818,18487,42133,71937,47244,04839,02463,622776	461
463	2.66558,09910,17953,13567,41931,08438,70855,40157,65450,46974,53874,838090	463
467	2.66931,68805,66112,16308,80510,89779,99674,10010,61401,55968,77553,654228	467
479	2.68033,55134,14563,22009,69639,66962,31078,27266,76340,01805,94696,676822	479
487	2.68752,89612,14634,33246,32050,64435,75372,38433,54413,59009,69060,272887	487
491	2.69108,14921,22968,47275,36909,83546,39435,54324,95219,43164,65484,935064	491
499	2.69810,05456,23389,91416,59050,36033,38846,73162,68889,76585,04407,216866	499
503	2.70156,79850,55927,39709,82240,90279,52805,50061,79311,53264,13100,626989	503
509	2.70671,77823,36758,74656,80767,11564,25501,75116,31022,82795,59327,732505	509
521	2.71683,77232,99524,47423,63411,86589,82340,55592,48804,35659,10389,037518	521
523	2.71850,16888,67274,23926,01265,78891,07882,05229,27624,54022,80340,618542	523
541	2.73319,72651,06569,43687,93482,43895,35766,02744,51126,54918,07249,958843	541
547	2.73798,73263,33430,77381,26473,72542,06411,41123,32573,38734,83672,544294	547
557	2.74585,51951,73728,90044,34334,98899,38696,26667.22982,65562,88916,047639	557
563	2.75050,83948,51346,22909,45827,07761,08389,89309,37510,02997,46276,527041	563
569	2.75511,22663,95071,17228,70555,24030,20058,87808,40566,56954.49337,662164	569
571	2.75663,61082,45848,05004,02841,30031,39578,08074,83371,59899,19622,253745	571
577	2.76117,58131,55731.42848,88336,67563,87165,18349,94631,00807,86067,506949	577
587	2.76863,81012,47614,47606,35592,98596,71376,19981,12599,05673,24995,758554	587
593	2.77305,46933,64262,60639,66715,59821,78133,09249,84055,79640,65224,216122	593
599	2.77742,68223,89311,37982,81725,69101,74684,25198,87827,14494,37552,485037	599
601	2.77887,44720,02739,52088,58506,99987,83983,48917,52297,24032,80181,145090	601
607	2.78318,86910,75257,58096,01956,30455,95072,14062,42317,98498,79486,868541	607
613	2.78746,04745,18415,03774,22662,81456,45078,29528,38564,77870,60511,887769	613
617	2.79028,51640,33241,68804,54661,67275,45331,98845,73431,10231,76836,317560	617
619	2.79169,06490,20117,97679,79674,34394,50849,41105,79264,06695,48606,134085	619
631	2.80002,93592,44134,31301,69298,49975,36836,15526,21483,45926,22618,819406	631
641	2.80685,80295,18817,42224,83770,09638,02810,30784,64091,37064,08860,016375	641
643	2.80821,09729,24222,07429,19385,05465,83232,48443,16034,72535,33279,475692	643
647	2.81090,42806,68700,38445,84305,62795,35772,33374,52752,88620,55534,785384	647

653	2.81491,31812,75073,92142,93105,65465,57968,44420,93073,59911,14836,790768	653
659	2.81888,54145,94009,86128,04846,07065,03884,71245,58914,63114,16630,487450	659
661	2.82020,14594,85640,23664,65718,97680,09240,24475,29556,41077,27411,001763	661
673	2.82801,50642,23976,84647,61709,94824,66587,84392,73852,95699,07219,527629	673
677	2.83058,86686,85144,31600,60170,60287,15791,96987,21869,42085,75219,422835	677
683	2.83442,07036,81532,56339,98239,41016,94314,12519,92074,22395,15101,356100	683
691	2.83947,80473,74198,40758,33677,24326,62643,33706,67025,71535,20888,200815	691
701	2.84571,80179,66658,65706,40223,37250,30440,16828,60606,06710,99378,642626	701
709	2.85064,62351,83066,54285,38844,79778,89914,12079,23464,57372,91344,715434	709
719	2.85672,88903,82882,60776,76506,51400,88113,55319,50785,66409,97910,273675	719
727	2.86153,44108,59037,83621,34642,48678,39613,39988,70242,96505,05660,769999	727
733	2.86510,39746,41127,94317,28131,02559,86776,12051,12268,36141,01539,967209	733
739	2.86864,44383,94825,73669,35855,14263,03827,78685,62960,06015,93030,162646	739
743	2.87098,88137,60575,29242,26723,41223,78639,86402,35201,25826,22906,420196	743
751	2.87563,99370,04168,38974,59851,09251,08913,79777,69486,72300,09449,287788	751
757	2.87909,58795,00072,75709,02275,46289,28831,29598,55610,77568,18424,909661	757
761	2.88138,46567,70572,82636,87243,35559,42944,66262,26115,19329,16113,770466	761
769	2.88592,63398,01431,03960,42922,39990,68928,55438,24266,73676,32539,540297	769
773	2.88817,94939,18324,90897,46881,27193,74602,82128,27448,51788,65363,250475	773
787	2.89597,47323,59064,55847,49105,93093,84403,00557,33235,30892,05759,509372	787
797	2.90145,83213,96112,34726,66008,27220,37150,60763,80048,04080,90214,871170	797
809	2.90794,85216,12272,30432,36285,45880,42151,46893,16537,70803,38111,022662	809
811	2.90902,08542,11156,03069,03308,48322,97484,96977,10258,36812,36616,489430	811
821	2.91434,31571,19440,77180,40593,41703,71406,12897,21030,05294,12843,73.072	821
823	2.91539,98352,12269,83976,77077,56599,55165,51291,17431,03959,46095,528115	823
827	2.91750,55095,52546,67071,16671,84496,53756,13593,71081,63043,50219,579982	827
829	2.91855,45305,50273,55311,51367,88077,88199,00092,68851,27047,81176,310395	829
839	2.92376,19608,28700,27499,86012,26886,40032,82838,28125,42235,16955,539741	839
853	2.93094,90311,67523,02999,84110,76276,53284,29746,89789,10727,91914,383868	853
857	2.93298,08219,23198,16429,25296,94730,29838,44651,50336,92985,47521,566946	857
859	2.93399,31638,31242,30262,85442,12269,31107,61700,39788,21370,78414,600987	859
863	2.93601,07957,15209,59266,36308,69754,18427,13577,12652,84446,77410,023962	863
877	2.94299,95933,66040,51822,80278,38057,14352,55114,87250,72879,32288,432978	877
881	2.94497,59084 2047,91274,23677,89471,82528,26645,36543,68702,11333,796990	881
883	2.94596,07035,77568,58561,59053,73327,89211,59[illegible]13,79689,03497,15640,730610	883
887	2.94792,36198,31726,39219,65090,14904,0[illegible]473,08873,98971,35988,60988,634764	887
907	2.95760,72870,60095,25584,72139,01553,62348,76134,78601,27524,63755,591947	907
911	2.95951,83769,72998,24763,28008,17777,19688,55416,00035,05336,77914,276734	911
919	2.96331,55113,86111,26519,69202,08586,23523,20678,28235,45128,04319,378878	919
929	2.96801,57139,93641,76318,47673,87869,08415,56826,51327,04702,61455,402055	929
937	2.97173,95908,87778,26302,75767,32122,15899,55792,61709,53802,51627,468099	937
941	2.97358,96234,27256,90834,22975,10551,79624,82320,81816,02752,59675,858750	941
947	2.97634,99790,03273,41875,01137,75925,22039,01622,95145,98964,50857,664310	947
953	2.97909,29006,38326,40853,29398.47717,31227,47302,58220,10598,20494,365710	953
967	2.98542,64740,83001,67359,77060,21186,62711,98227,26427,50112,13308,635787	967
971	2.98721,92299,08004,86280,31389,06536,25140,40531,99480,84889,06195,031834	971
977	2.98989,45637,18773,07091,48028,11052,34926,25914,08310,84838,41813,133125	977
983	2.99255,35178,32135,62274,96349,24741,43755,19748,99290,01915,16629,651606	983
991	2.99607,36544,85275,32636,44343,78815,42086,41325,12663,22812,08187,848418	991
997	2.99869,51583,11655,71988,13717,02813,27239,27091,29009,56252,34578,237114	997
1009	3.00389,11662,36910,52171,52813,16509,55886,55201,95652,55260,09846,352385	1009
1013	3.00560,94453,60280,42845,01617,20070,22165,08630,76662,06266,67962,258954	1013
1019	3.00817,41840,06426,39490,49899,22311,83296,76922,24936,36781,15542,425256	1019
1021	3.00902,57420,86910,24724,81480,36966,37851,03031,35315,99655,45437,518936	1021
1031	3.01325,86652,83516,54690,96644,09013,44583,24998,28006,59445,12546,301730	1031
1033	3.01410,03215,19620,57904,40100,62744,77060,74356,51400,55338,40683,272162	1033
1039	3.01661,55475,57177,41240,21010,01361,62758,71828,97066,20300,27455,551333	1039
1049	3.02077,54881,93557,85990,72007,63899,91741,19141,56191,40400,29271,212173	1049
1051	3.02160,27160,28242,22008,37688,89097,91687,94575,69660,00863,13290,071509	1051
1061	3.02571,53839,01340,66612,28844,73990,78253,18778,56167,59546,12209,837461	1061
1063	3.02653,32645,23296,75697,14741,94622,85093,72551,33664,50701,42150,299662	1063
1069	3.02897,77052,08778,01749,01456,79857,36936,27594,48925,00824,96999,029598	1069
1087	3.03622,95440,86294,53992,62573,76344,44115,71246,06239,23536,42216,494710	1087
1091	3.03782,47505,88341,87761,10634,29318,59826,96526,11482,20421,01725,763338	1091
1093	3.03862,01619,49702,79226,92555,27640,43892,49476,76830,67575,50087,010561	1093
1097	3.04020,66275,74711,13221,54832,40551,60744,80236,80562,48547,77531,009418	1097

Num.	Logarithms	1st Diff. for thirty places.	2d Difference.	3d Diff.	4th Diff
999981	5.99999,17483,26452,69127,56375,77656,08962,21404,13967,11162,41559,559715	4343,02516,49984,32672,97511	434,31011,69269,61875	86,86371,72279	26,05955
999982	5.99999,21826,28969,19111,89048,75167,10168,04410,45670,14259,12188,941905	4343,02082,18972,63403,35636	434,30924 82923,95551	86,86345,66324	26,05944
999983	5.99999,26169,31051,38084,52452,10802,66096,56534,44751,10145,02103.223584	4343 01647,88047,80479,40085	434,30837,96604,35171	86,86319,60380	26,05934
999984	5.99999,30512,32699,26132,32931,50887,25274,51319,92733,51291,27922,567440	4343,01213,57209,83875,04914	434,30751,10310,80724	86,86293,54447	26,05923
999985	5.99999,34855,33912,83342,16806,55801,27117,84944,36362,28023,25749,699059	4343,00779,26458,73564,24190	434,30664,24043,32200	86,86267 48523	26,05913
999986	5.99999,39198.34692,09800,90370,79991,44324,51332,71808,67008,73189,814585	4343,00344,95794,49520,91990	434,30577,37801,89590	86,86241,42611	26,05902
999987	5.99999,43541,35037,05595,39891,71981,25261,96067,87693,74442,46590,776319	4342,99910,65217,11719,02400	434,30490,51586,52881	86.86215,36708	26 05892
999988	5.99999,47884,34947,70812,51610,74381,36349,49100,79656,19543,53030,647037	4342,99476,34726,60132,49519	434,30403,65397,22065	86,86189,30816	26,05882
999989	5.99999,52227,34424,05539.11743,23900,04435,36263,49188,35071,07900,692711	4342,99042,04322,94735,27454	434,30316,79233,97130	86,86163,24935	26,05871
999990	5.99999,56570,33466,09862,06478,51353,59168,69587,99461,92655,35383,630563	4342,98607,74006,15501,30323	434,30229,93096,78067	86,86137,19064	26,05861
999991	5.99999,60913,32073,83868,21979,81676,75366,16434,40862,91833,50707,313655	4342,98173,43776,22404,52256	434,30143,06985,64864	86,86111,13203	26,05850
999992	5.99999,65256,30247,27644,44384,33933,15373,47431,18952,82774,39761,698523	4342,97739,13633,15418,87393	434,30056,20900,57511	86,86085,07353	26,05840
999993	5.99999,69599,27986,41277,59803,21325,71421,63230,77571,23772,83500,257375	4342,97304,83576,94518,29881	434,29969,34841,55998	86,86059,01513	26,05829
999994	5.99999,73942,25291,24854,54321,51207,07978,00083,69792,55691,81504,395062	4342,96870,53607,59676,73883	434,29882,48808,60315	86,86032,95683	26,05819
999995	5.99999,78285,22161,78462,13998,25090,04092,14234,29447,56631,11169,337238	4342,96436,23725,10868,13568	434,29795,62801,70451	86,86006,89864	26,05809
999996	5.99999,82628,18598,02187,24866,38657,95736,45141,15918,21202,16170,793707	4342,96001,93929,48066,43117	434,29708,76820,86395	86,85980,84056	26,05798
999997	4.99999,86971,14599,96116,72932,81775,18141,57525,44911,89892,50191,893880	4342,95567,64220,71245,56722	434,29621,90866,08137	86,85954,78258	26,05788
999998	5.99999,91314,10167,60337,44178,38497,48126,62250,17919,35108,09327,863417	4342,95133,34598,80379,48585	434,29535,04937,35667	86,85928,72470	26,05777
999999	5,99999,95657.05300,94936,24557,87082,46424,16033,63057,91588,69140,086418	4342,94699,05063,75442,12918	434,29448 19034,68975	86,85902,66693	26,05767
1000000	6.00000,00000,50000,00000,00000,00000,00000,00900,00000,00000,00000,000000	4342,94264,75615,56407,43943	434,29361,33158,08049	86,85876,60926	26,05756
1000001	6.00000,04342,94264,75615,56407,43942,64367,77070,41684,13616,67145,121612	4342,93830,46254,23249,35893	434,29274,47307,52880	86,85850,55169	26,05746
1000002	6.00000,08685,88095,21869,79656,79836,05898,28197,45503,99122,29762,838046	4342,93396,16979,75941,83013	434 29187,61483,03457	86,85824,49423	26,05736
1000003	6.00000,13028,81491,38849,55598,62849,44123,67446,26668,43666,36420,812810	4342,92961,87792,14458,79556	434,29100,75684,59769	86,85798,43688	26,05725
1000004	6.00000,17371,74453,26641,70057,42405,94036,35925,46423,61433,72274,419302	4342,92527,58691,38774,19787	434,29013,89912,21807	86,85772,37962	26,05715
1000005	6.00000,21714,66980,85333,08831,62193,08382,74570,87825,74099,46699,905138	4342,92093,29677,48861,97980	434,28927,04165,89559	86,85746,32248	26,05704
1000006	6.00000,26057,59074,15010,57693,60173,19951.75785,31751,20661,18325,462073	4342 91659,00750,44696,08421	434,28840,18445,63016	86,85720,26543	26,05694
1000007	6.00000,30400,50733,15761,02389,68593,83858,13937,45828,33261,37859,440297	4342,91224,71910,26250,45404	434,28753,32751,42167	86,85694,20849	26,05684
1000008	6.00000,34743,41957,87671,28640,13998,19820,54722,98972,96735,47644,029504	4342,90790,43156,93499,03237	434,28666,47083,27001	86 85668,15166	26,05673
1000009	6.00000,39086,32748,30828,22139,17235,54434,43391,14207,90745,10492,256220	4342,90356,14490,46415,76236	434,28579 61441,17509	86,85642,09493	26,05663
1000010	6.00000,43429,23104,45318.68554,93471,63439,71839,72443,94482,49094,541444	4342,89921,85910,84974,58728	434,28492,75825.13679	86,85616,03830	26,05652
1000011	6.00000,47772,13026,31229,53529,52199,13983,24581,79898,15059,61106,748890	4342,89487,57418,09149,45049	434,28405,90235,15501	86,85589,98178	26,05642
1000012	6.00000,52115,02513,88647,62678,97248,06876,03587,11822,81825,33953,056166	4342,89053,29012,18914,29548	434,28319,04671,22965	86,85563,92536	26,05631
1000013	6.00000,56457,91567,17659,81593,26796,18845,32001,45216,29985,17392,523170	4342,88619,00693,14243,06583	434,28232,19133,36060	86,85537,86905	26,05621
1000014	6.00000,60800,80186,18352,95836,33379,44781,36746,93184,78031,21006,338144	4342,88184,72460,95109,70523	434,28145,33621,54777	86,85511,81284	26,05611
1000015	6.00000,65143,68370,90813,90946,03902,39979,10006,53621,14624,87961,816189	4342,87750,44315,61488,15746	434,28058,48135,79104	86,85485,75673	26,05600
				86,85459,70073	26,05590

DECIMALS OF AN INCH FOR EACH $\frac{1}{64}$th.

$\frac{1}{32}$ds.	$\frac{1}{64}$ths.	Decimal.	Fraction.	$\frac{1}{32}$ds.	$\frac{1}{64}$ths.	Decimal.	Fraction.
	1	.015625			33	.515625	
1	2	.03125		17	34	.53125	
	3	.046875			35	.546875	
2	4	.0625	1–16	18	36	.5625	9–16
	5	.078125			37	.578125	
3	6	.09375		19	38	.59375	
	7	.109375			39	.609375	
4	8	.125	1–8	20	40	.625	5–8
	9	.140625			41	.640625	
5	10	.15625		21	42	.65625	
	11	.171875			43	.671875	
6	12	.1875	3–16	22	44	.6875	11–16
	13	.203125			45	.703125	
7	14	.21875		23	46	.71875	
	15	.234375			47	.734375	
8	16	.25	1–4	24	48	.75	3–4
	17	.265625			49	.765625	
9	18	.28125		25	50	.78125	
	19	.296875			51	.796875	
10	20	.3125	5–16	26	52	.8125	13–16
	21	.328125			53	.828125	
11	22	.34375		27	54	.84375	
	23	.359375			55	.859375	
12	24	.375	3–8	28	56	.875	7–8
	25	.390625			57	.890625	
13	26	.40625		29	58	.90625	
	27	.421875			59	.921875	
14	28	.4375	7–16	30	60	.9375	15–16
	29	.453125			61	.953125	
15	30	.46875		31	62	.96875	
	31	.484375			63	.984375	
16	32	.5	1–2	32	64	1.	1

DECIMAL PARTS OF A FOOT FOR EACH $\frac{1}{64}$th OF AN INCH.

Inch.	0″	1″	2″	3″	4″	5″	6″	7″	8″	9″	10″	11″
0	0	.0833	.1667	.2500	.3333	.4167	.5000	.5833	.6667	.7500	.8333	.9167
$\frac{1}{64}$	.0013	.0846	.1680	.2513	.3346	.4180	.5013	.5846	.6680	.7513	.8346	.9180
$\frac{1}{32}$	.0026	.0859	.1693	.2526	.3359	.4193	.5026	.5859	.6693	.7526	.8359	.9193
$\frac{3}{64}$	.0039	.0872	.1706	.2539	.3372	.4206	.5039	.5872	.6706	.7539	.8372	.9206
$\frac{1}{16}$	.0052	.0885	.1719	.2552	.3385	.4219	.5052	.5885	.6719	.7552	.8385	.9219
$\frac{5}{64}$	.0065	.0898	.1732	.2565	.3398	.4232	.5065	.5898	.6732	.7565	.8398	.9232
$\frac{3}{32}$	.0078	.0911	.1745	.2578	.3411	.4245	.5078	.5911	.6745	.7578	.8411	.9245
$\frac{7}{64}$	.0091	.0924	.1758	.2591	.3424	.4258	.5091	.5924	.6758	.7591	.8424	.9258
$\frac{1}{8}$	.0104	.0937	.1771	.2604	.3437	.4271	.5104	.5937	.6771	.7604	.8437	.9271
$\frac{9}{64}$	.0117	.0951	.1784	.2617	.3451	.4284	.5117	.5951	.6784	.7617	.8451	.9284
$\frac{5}{32}$	.0130	.0964	.1797	.2630	.3464	.4297	.5130	.5964	.6797	.7630	.8464	.9297
$\frac{11}{64}$	.0143	.0977	.1810	.2643	.3477	.4310	.5143	.5977	.6810	.7643	.8477	.9310
$\frac{3}{16}$	.0156	.0990	.1823	.2656	.3490	.4323	.5156	.5990	.6823	.7656	.8490	.9323
$\frac{13}{64}$	.0169	.1003	.1836	.2669	.3503	.4336	.5169	.6003	.6836	.7669	.8503	.9336
$\frac{7}{32}$	.0182	.1016	.1849	.2682	.3516	.4349	.5182	.6016	.6849	.7682	.8516	.9349
$\frac{15}{64}$	.0195	.1029	.1862	.2695	.3529	.4362	.5195	.6029	.6862	.7695	.8529	.9362
$\frac{1}{4}$	.0208	.1042	.1875	.2708	.3542	.4375	.5208	.6042	.6875	.7708	.8542	.9375

DECIMAL PARTS OF A FOOT FOR EACH $\frac{1}{64}$th OF AN INCH.—Continued.

INCH.	0″	1″	2″	3″	4″	5″	6″	7″	8″	9″	10″	11″
$\frac{17}{64}$	.0221	.1055	.1888	.2721	.3555	.4388	.5221	.6055	.6888	.7721	.8555	.9388
$\frac{9}{32}$	.0234	.1068	.1901	.2734	.3568	.4401	.5234	.6068	.6901	.7734	.8568	.9401
$\frac{19}{64}$	.0247	.1081	.1914	.2747	.3581	.4414	.5247	.6081	.6914	.7747	.8581	.9414
$\frac{5}{16}$	.0260	.1094	.1927	.2760	.3594	.4427	.5260	.6094	.6927	.7760	.8594	.9427
$\frac{21}{64}$	.0273	.1107	.1940	.2773	.3607	.4440	.5273	.6107	.6940	.7773	.8607	.9440
$\frac{11}{32}$	.0286	.1120	.1953	.2786	.3620	.4453	.5286	.6120	.6953	.7786	.8620	.9453
$\frac{23}{64}$	.0299	.1133	.1966	.2799	.3633	.4466	.5299	.6133	.6966	.7799	.8633	.9466
$\frac{3}{8}$	.0312	.1146	.1979	.2812	.3646	.4479	.5312	.6146	.6979	.7812	.8646	.9479
$\frac{25}{64}$	.0326	.1159	.1992	.2826	.3659	.4492	.5326	.6159	.6992	.7826	.8659	.9492
$\frac{13}{32}$	.0339	.1172	.2005	.2839	.3672	.4505	.5339	.6172	.7005	.7839	.8672	.9505
$\frac{27}{64}$	.0352	.1185	.2018	.2852	.3685	.4518	.5352	.6185	.7018	.7852	.8685	.9518
$\frac{7}{16}$	.0365	.1198	.2031	.2865	.3698	.4531	.5365	.6198	.7031	.7865	.8698	.9531
$\frac{29}{64}$	.0378	.1211	.2044	.2878	.3711	.4544	.5378	.6211	.7044	.7878	.8711	.9544
$\frac{15}{32}$	.0391	.1224	.2057	.2891	.3724	.4557	.5391	.6224	.7057	.7891	.8724	.9557
$\frac{31}{64}$	.0404	.1237	.2070	.2904	.3737	.4570	.5404	.6237	.7070	.7904	.8737	.9570
$\frac{1}{2}$	.0417	.1250	.2083	.2917	.3750	.4583	.5417	.6250	.7083	.7917	.8750	.9583

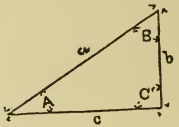
DECIMAL PARTS OF A FOOT FOR EACH $\frac{1}{64}$th OF AN INCH.—Continued.

INCH.	0″	1″	2″	3″	4″	5″	6″	7″	8″	9″	10″	11″
$\frac{33}{64}$	.0430	.1263	.2096	.2930	.3763	.4596	.5430	.6263	.7096	.7930	.8763	.9596
$\frac{17}{32}$	.0443	.1276	.2109	.2943	.3776	.4609	.5443	.6276	.7109	.7943	.8776	.9609
$\frac{35}{64}$	.0456	.1289	.2122	.2956	.3789	.4622	.5456	.6289	.7122	.7956	.8789	.9622
$\frac{9}{16}$	.0469	.1302	.2135	.2969	.3802	.4635	.5469	.6302	.7135	.7969	.8802	.9635
$\frac{37}{64}$	.0482	.1315	.2148	.2982	.3815	.4648	.5482	.6315	.7148	.7982	.8815	.9648
$\frac{19}{32}$	.0495	.1328	.2161	.2995	.3828	.4661	.5495	.6328	.7161	.7995	.8828	.9661
$\frac{39}{64}$	.0508	.1341	.2174	.3008	.3841	.4674	.5508	.6341	.7174	.8008	.8841	.9674
$\frac{5}{8}$	.0521	.1354	.2188	.3021	.3854	.4688	.5521	.6354	.7188	.8021	.8854	.9688
$\frac{41}{64}$	.0534	.1367	.2201	.3034	.3867	.4701	.5534	.6367	.7201	.8034	.8867	.9701
$\frac{21}{32}$	.0547	.1380	.2214	.3047	.3880	.4714	.5547	.6380	.7214	.8047	.8880	.9714
$\frac{43}{64}$	.0560	.1393	.2227	.3060	.2893	.4727	.5560	.6393	.7227	.8060	.8893	.9727
$\frac{11}{16}$	.0573	.1406	.2240	.3073	.3906	.4740	.5573	.6406	.7240	.8073	.8906	.9740
$\frac{45}{64}$	.0586	.1419	.2253	.3086	.3919	.4753	.5586	.6419	.7253	.8086	.8919	.9753
$\frac{23}{32}$	.0599	.1432	.2266	.3099	.3932	.4766	.5599	.6432	.7266	.8099	.8932	.9766
$\frac{47}{64}$	.0612	.1445	.2279	.3112	.3945	.4779	.5612	.6445	.7279	.8112	.8945	.9779
$\frac{3}{4}$	.0625	.1458	.2292	.3125	.3958	.4792	.5625	.6458	.7292	.8125	.8958	.9792

DECIMAL PARTS OF A FOOT FOR EACH $\frac{1}{64}$th OF AN INCH.—Continued.

INCH.	0″	1″	2″	3″	4″	5″	6″	7″	8″	9″	10″	11″
$\frac{49}{64}$	.0638	.1471	.2305	.3138	.3971	.4805	.5638	.6471	.7305	.8138	.8971	.9805
$\frac{25}{32}$	.0651	.1484	.2318	.3151	.3984	.4818	.5651	.6484	.7318	.8151	.8984	.9818
$\frac{51}{64}$	.0664	.1497	.2331	.3164	.3997	.4831	.5664	.6497	.7331	.8164	.8997	.9831
$\frac{13}{16}$	.0677	.1510	.2344	.3177	.4010	.4844	.5677	.6510	.7344	.8177	.9010	.9844
$\frac{53}{64}$	.0690	.1523	.2357	.3190	.4023	.4857	.5690	.6523	.7357	.8190	.9023	.9857
$\frac{27}{32}$	.0703	.1536	.2370	.3203	.4036	.4870	.5703	.6536	.7370	.8203	.9036	.9870
$\frac{55}{64}$	.0716	.1549	.2383	.3216	.4049	.4883	.5716	.6549	.7383	.8216	.9049	.9883
$\frac{7}{8}$	.0729	.1562	.2396	.3229	.4062	.4896	.5729	.6562	.7396	.8229	.9062	.9896
$\frac{57}{64}$	.0742	.1576	.2409	.3242	.4076	.4909	.5742	.6576	.7409	.8242	.9076	.9909
$\frac{29}{32}$	.0755	.1589	.2422	.3255	.4089	.4922	.5755	.6589	.7422	.8255	.9089	.9922
$\frac{59}{64}$	.0768	.1602	.2435	.3268	.4102	.4935	.5768	.6602	.7435	.8268	.9102	.9935
$\frac{15}{16}$	.0781	.1615	.2448	.3281	.4115	.4948	.5781	.6615	.7448	.8281	.9115	.9948
$\frac{61}{64}$	.0794	.1628	.2461	.3294	.4128	.4961	.5794	.6628	.7461	.8294	.9128	.9961
$\frac{31}{32}$	.0807	.1641	.2474	.3307	.4141	.4974	.5807	.6641	.7474	.8307	.9141	.9974
$\frac{63}{64}$	.0820	.1654	.2487	.3320	.4154	.4987	.5820	.6654	.7487	.8320	.9154	.9987
1												1.0000

RIGHT TRIANGLES



TO FIND A.

GIVEN.	FORMULÆ.	GIVEN.	FORMULÆ.
b, c	$\tan A = \frac{b}{c}$	c, b	$\cot A = \frac{c}{b}$
b, a	$\sin A = \frac{b}{a}$	c, a	$\cos A = \frac{c}{a}$

TO FIND B.

b, c	$\cot B = \frac{b}{c}$	c, b	$\tan B = \frac{c}{b}$
b, a	$\cos B = \frac{b}{a}$	c, a	$\sin B = \frac{c}{a}$

TO FIND a.

A, b	$a = \frac{b}{\sin A}$	B, b	$a = \frac{b}{\cos B}$
A, c	$a = \frac{c}{\cos A}$	B, c	$a = \frac{c}{\sin B}$

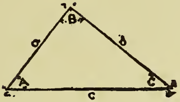
TO FIND b.

A, c	$b = c \tan A$	B, a	$b = a \cos B$
A, a	$b = a \sin A$	B, c	$b = c \cot B$

TO FIND c.

A, a	$c = a \cos A$	B, a	$c = a \sin B$
A, b	$c = b \cot A$	B, b	$c = b \tan B$

OBLIQUE TRIANGLES



TO FIND a, b, c.

GIVEN.	FORMULÆ.
A, b, C	$a = \frac{b \sin C}{\sin A}$
A, B, c	$b = \frac{c \sin A}{\sin B}$
A, B, b	$c = \frac{b \sin B}{\sin A}$

TO FIND A, B, C.

GIVEN.	FORMULÆ.
a, b, C	$\sin A = \frac{b \sin C}{a}$
A, b, c	$\sin B = \frac{c \sin A}{b}$
A, a, b	$\sin C = \frac{a \sin A}{b}$

TO FIND A, B, C.

$s = \frac{1}{2}(a + b + c).$

GIVEN.	FORMULÆ.
a, c, s	$\sin \frac{1}{2}A = \sqrt{\frac{(s-a)(s-c)}{ac}}$
a, b, s	$\sin \frac{1}{2}B = \sqrt{\frac{(s-a)(s-b)}{ab}}$
b, c, s	$\sin \frac{1}{2}C = \sqrt{\frac{(s-b)(s-c)}{bc}}$

Degrees	SINE.							
	0′	10′	20′	30′	40′	50′	60′	
0	0.00000	0.00291	0.00582	0.00873	0.01164	0.01454	0.01745	89
1	0.01745	0.02036	0.02327	0.02618	0.02908	0.03199	0.03490	88
2	0.03490	0.03781	0.04071	0.04362	0.04653	0.04943	0.05234	87
3	0.05234	0.05524	0.05814	0.06105	0.06395	0.06685	0.06976	86
4	0.06976	0.07266	0.07556	0.07846	0.08136	0.08426	0.08716	85
5	0.08716	0.09005	0.09295	0.09585	0.09874	0.10164	0.10453	84
6	0.10453	0.10742	0.11031	0.11320	0.11609	0.11898	0.12187	83
7	0.12187	0.12476	0.12764	0.13053	0.13341	0.13629	0.13917	82
8	0.13917	0.14205	0.14493	0 14781	0.15069	0.15356	0.15643	81
9	0.15643	0.15931	0.16218	0.16505	0.16792	0.17078	0.17365	80
10	0.17365	0.17651	0.17937	0.18224	0.18500	0.18795	0.19081	79
11	0.19081	0.19366	0.19652	0.19937	0.20222	0.20507	0.20791	78
12	0.20791	0.21076	0.21360	0.21644	0.21928	0.22212	0.22495	77
13	0.22495	0.22778	0.23062	0.23345	0.23627	0.23910	0.24192	76
14	0.24192	0.24474	0.24756	0.25038	0.25320	0.25601	0.25882	75
15	0.25882	0.26163	0.26443	0.26724	0.27004	0.27284	0.27564	74
16	0.27564	0.27843	0.28123	0.28402	0.28680	0.28959	0.29237	73
17	0.29237	0.29515	0.29793	0.30071	0.30348	0.30625	0.30902	72
18	0.30902	0.31178	0.31454	0.31730	0.32006	0.32282	0.32557	71
19	0.32557	0.32832	0.33106	0.33381	0.33655	0.33929	0.34202	70
20	0.34202	0.34475	0.34748	0.35021	0.35293	0.35565	0.35837	69
21	0.35837	0.36108	0.36379	0.36650	0.36921	0.37191	0.37461	68
22	0.37461	0.37730	0.37999	0.38268	0.38537	0.38805	0.39073	67
23	0.39073	0.39341	0.39608	0.39875	0.40142	0.40408	0.40674	66
24	0.40674	0.40939	0.41204	0.41469	0.41734	0.41998	0.42262	65
25	0.42262	0.42525	0.42788	0.43051	0.43318	0.43575	0.43837	64
26	0.43837	0.44098	0.44359	0.44620	0.44880	0.45140	0.45399	63
27	0.45399	0.45658	0.45917	0.46175	0.46433	0.46690	0.46947	62
28	0.46947	0.47204	0.47460	0.47716	0.47971	0.48226	0.48481	61
29	0.48481	0.48735	0.48989	0.49242	0.49495	0.49748	0.50000	60
30	0.50000	0.50252	0.50503	0.50754	0.51004	0.51254	0.51504	59
31	0.51504	0.51753	0.52002	0.52250	0.52498	0.52745	0.52992	58
32	0.52992	0.53238	0.53484	0.53730	0.53975	0.54220	0.54464	57
33	0.54464	0.54708	0.54951	0.55194	0.55436	0.55678	0.55919	56
34	0.55919	0.56160	0.56401	0.56641	0.56880	0.57119	0.57358	55
35	0.57358	0.57596	0.57833	0.58070	0.58307	0.58543	0.58779	54
36	0.58779	0.59014	0.59248	0.59482	0.59716	0.59949	0.60182	53
37	0.60182	0.60414	0.60645	0.60876	0.61107	0.61337	0.61566	52
38	0.61566	0.61795	0.62024	0.62251	0.62479	0.62706	0.62932	51
39	0.62932	0.63158	0.63383	0.63608	0.63832	0.64056	0.64279	50
40	0.64279	0.64501	0.64723	0.64945	0.65166	0.65386	0.65606	49
41	0.65606	0.65825	0.66044	0.66262	0.66480	0.66697	0.66913	48
42	0.66913	0.67129	0.67344	0.67559	0.67773	0.67987	0.68200	47
43	0.68200	0.68412	0.68624	0.68835	0 69046	0.69256	0.69466	46
44	0.69466	0.69675	0.69883	0.70091	0.70298	0.70505	0.70711	45
	60′	50′	40′	30′	20′	10′	0′	Degrees
	COSINE.							

Degrees	COSINE.							
	0′	10′	20′	30′	40′	50′	60′	
0	1.00000	1.00000	0.99998	0.99996	0.99993	0.99989	0.99985	89
1	0.99985	0.99979	0.99973	0.99966	0.99958	0.99949	0.99939	88
2	0.99939	0.99929	0.99917	0.99905	0.99892	0.99878	0.99863	87
3	0.99863	0.99847	0.99831	0.99813	0.99795	0.99776	0.99756	86
4	0.99756	0.99736	0.99714	0.99692	0.99668	0.99644	0.99619	85
5	0.99619	0.99594	0.99567	0.99540	0.99511	0.99482	0.99452	84
6	0.99452	0.99421	0.99390	0.99357	0.99324	0.99290	0.99255	83
7	0.99255	0.99219	0.99182	0.99144	0.99106	0.99067	0.99027	82
8	0.99027	0.98986	0.98944	0.98902	0.98858	0.98814	0.98769	81
9	0.98769	0 98723	0.98676	0.98629	0.98580	0.98531	0.98481	80
10	0.98481	0.98430	0.98378	0.98325	0.98272	0.98218	0.98163	79
11	0.98163	0.98107	0.98050	0.97992	0.97934	0.97875	0.97815	78
12	0.97815	0.97754	0.97692	0.97630	0.97566	0.97502	0.97437	77
13	0.97437	0.97371	0.97304	0.97237	0.97169	0.97100	0.97030	76
14	0.97030	0.96959	0.96887	0.96815	0.96742	0.96667	0.96593	75
15	0.96593	0.96517	0.96440	0.96363	0.96285	0.90206	0.96126	74
16	0.96126	0.96046	0.95964	0.95882	0.95799	0.95715	0.95630	73
17	0.95630	0.95545	0.95459	0.95372	0.95284	0.95195	0.95106	72
18	0.95106	0.95015	0.94924	0.94832	0.94740	0.94646	0.94552	71
19	0.94552	0.94457	0.94361	0.94264	0.94167	0.94068	0.93969	70
20	0.93969	0.93869	0.93769	0.93667	0.93565	0.93462	0.93358	69
21	0.93358	0.93253	0.93148	0.93042	0.92935	0.92827	0.92718	68
22	0.92718	0.92609	0.92499	0.92388	0.92276	0.92164	0.92050	67
23	0.92050	0.91936	0.91822	0.91706	0.91590	0.91472	0.91355	66
24	0.91355	0.91236	0.91116	0.90996	0.90875	0.90753	0.90631	65
25	0.90631	0.90507	0.90383	0.90259	0.90133	0.90007	0.89879	64
26	0.89879	0.89752	0.89623	0.89493	0.89363	0.89232	0.89101	63
27	0.89101	0.88968	0.88835	0.88701	0.88566	0.88431	0.88295	62
28	0.88295	0 88158	0.88020	0.87882	0.87743	0.87603	0.87462	61
29	0.87462	0.87321	0.87178	0.87036	0.86892	0.86748	0.86603	60
30	0.86603	0.86457	0.86310	0.86163	0.86015	0.85866	0.85717	59
31	0.85717	0.85567	0.85416	0.85264	0.85112	0.84959	0.84805	58
32	0.84805	0.84650	0.84495	0.84339	0.84182	0.84025	0.83867	57
33	0.83867	0.83708	0.83549	0.83389	0.83228	0.83066	0.82904	56
34	0.82904	0.82741	0.82577	0.82413	0.82248	0.82082	0.81915	55
35	0.81915	0.81748	0.81580	0.81412	0.81242	0.81072	0.80902	54
36	0.80902	0.80730	0.80558	0.80386	0.80212	0.80038	0.79864	53
37	0.79864	0.79688	0.79512	0.79335	0.79158	0.78980	0.78801	52
38	0.78801	0.78622	0.78442	0.78261	0.78079	0.77897	0.77715	51
39	0.77715	0.77531	0.77347	0.77162	0.76977	0.76791	0.76604	50
40	0.76604	0.76417	0.76229	0.76041	0.75851	0.75661	0.75471	49
41	0.75471	0.75280	0.75088	0.74896	0.74703	0.74509	0.74314	48
42	0.74314	0.74120	0.73924	0.73728	0.73531	0.73333	0.73135	47
43	0.73135	0.72937	0.72737	0.72537	0.72337	0.72136	0.71934	46
44	0.71934	0.71732	0.71529	0.71325	0.71121	0.70916	0.70711	45
	60′	50′	40′	30′	20′	10′	0′	Degrees
	SINE.							

Degrees	TANGENT							
	0′	10′	20′	30′	40′	50′	60′	
0	0.00000	0.00291	0.00582	0.00873	0.01164	0.01455	0.01746	89
1	0.01746	0.02036	0.02328	0.02619	0.02910	0.03201	0.03492	88
2	0.03492	0.03783	0.04075	0.04366	0.04658	0.04949	0.05241	87
3	0.05241	0.05533	0.05824	0.06116	0.06408	0.06700	0.06993	86
4	0.06993	0.07285	0.07578	0.07870	0.08163	0.08456	0.08749	85
5	0.08749	0.09042	0.09335	0.09629	0.09923	0.10216	0.10510	84
6	0.10510	0.10805	0.11099	0.11394	0.11688	0.11983	0.12278	83
7	0.12278	0.12574	0.12869	0.13165	0.13461	0.13758	0.14054	82
8	0.14054	0.14351	0.14648	0.14945	0.15243	0.15540	0.15838	81
9	0.15838	0.16137	0.16435	0.16734	0.17033	0.17333	0.17633	80
10	0.17633	0.17933	0.18233	0.18534	0.18835	0.19136	0.19438	79
11	0.19438	0.19740	0.20042	0.20345	0.20648	0.20952	0.21256	78
12	0.21256	0.21560	0.21864	0.22169	0.22475	0.22781	0.23087	77
13	0.23087	0.23393	0.23700	0.24008	0.24316	0.24624	0.24933	76
14	0.24933	0.25242	0.25552	0.25862	0.26172	0.26483	0.26795	75
15	0.26795	0.27107	0.27419	0.27732	0.28046	0.28360	0.28675	74
16	0.28675	0.28990	0.29305	0.29621	0.29938	0.30255	0.30573	73
17	0.30573	0.30891	0.31210	0.31530	0.31850	0.32171	0.32492	72
18	0.32492	0.32814	0.33136	0.33460	0.33783	0.34108	0.34433	71
19	0.34433	0.34758	0.35085	0.35412	0.35740	0.36068	0.36397	70
20	0.36397	0.36727	0.37057	0.37388	0.37720	0.38053	0.38386	69
21	0.38386	0.38721	0.39055	0.39391	0.39727	0.40065	0.40403	68
22	0.40403	0.40741	0.41081	0.41421	0.41763	0.42105	0.42447	67
23	0.42447	0.42791	0.43136	0.43481	0.43828	0.44175	0.44523	66
24	0.44523	0.44872	0.45222	0.45573	0.45924	0.46277	0.46631	65
25	0.46631	0.46985	0.47341	0.47698	0.48055	0.48414	0.48773	64
26	0.48773	0.49134	0.49495	0.49858	0.50222	0.50587	0.50953	63
27	0.50953	0.51320	0.51688	0.52057	0.52427	0.52798	0.53171	62
28	0.53171	0.53545	0.53920	0.54296	0.54674	0.55051	0.55431	61
29	0.55431	0.55812	0.56194	0.56577	0.56962	0.57348	0.57735	60
30	0.57735	0.58124	0.58513	0.58905	0.59297	0.59691	0.60086	59
31	0.60086	0.60483	0.60881	0.61280	0.61681	0.62083	0.62487	58
32	0.62487	0.62892	0.63299	0.63707	0.64117	0.64528	0.64941	57
33	0.64941	0.65355	0.65771	0.66189	0.66608	0.67028	0.67451	56
34	0.67451	0.67875	0.68301	0.68728	0.69157	0.69588	0.70021	55
35	0.70021	0.70455	0.70891	0.71329	0.71769	0.72211	0.72654	54
36	0.72654	0.73100	0.73547	0.73996	0.74447	0.74900	0.75355	53
37	0.75355	0.75812	0.76272	0.76733	0.77196	0.77661	0.78129	52
38	0.78129	0.78598	0.79070	0.79544	0.80020	0.80498	0.80978	51
39	0.80978	0.81461	0.81946	0.82434	0.82923	0.83415	0.83910	50
40	0.83910	0.84407	0.84906	0.85408	0.85912	0.86419	0.86929	49
41	0.86929	0.87441	0.87955	0.88473	0.88992	0.89515	0.90040	48
42	0.90040	0.90569	0.91099	0.91633	0.92170	0.92709	0.93252	47
43	0.93252	0.93797	0.94345	0.94896	0.95451	0.96008	0.96569	46
44	0.96569	0.97133	0.97700	0.98270	0.98843	0.99420	1.00000	45
	60′	50′	40′	30′	20′	10′	0′	Degrees
	COTANGENT							

Degrees	COTANGENT							
	0′	10′	20′	30′	40′	50′	60′	
0	∞	343.77371	171.88540	114.58865	85.93979	68.75009	57.28996	89
1	57.28996	49.10388	42.96408	38.18846	34.36777	31.24158	28.63625	88
2	28.63625	26.43160	24.54176	22.90377	21.47040	20.20555	19.08114	87
3	19.08114	18.07498	17.16934	16.34986	15.60478	14.92442	14.30067	86
4	14.30067	13.72674	13.19688	12.70621	12.25051	11.82617	11.43005	85
5	11.43005	11.05943	10.71191	10.38540	10.07803	9.78817	9.51436	84
6	9.51436	9.25530	9.00983	8.77689	8.55555	8.34496	8.14435	83
7	8.14435	7.95302	7.77035	7.59575	7.42871	7.26873	7.11537	82
8	7.11537	6.96823	6.82694	6.69116	6.56055	6.43484	6.31375	81
9	6.31375	6.19703	6.08444	5.97576	5.87080	5.76937	5.67128	80
10	5.67128	5.57638	5.48451	5.39552	5.30928	5.22566	5.14455	79
11	5.14455	5.06584	4.98940	4.91516	4.84300	4.77286	4.70463	78
12	4.70463	4.63825	4.57363	4.51071	4.44942	4.38969	4.33148	77
13	4.33148	4.27471	4.21933	4.16530	4.11256	4.06107	4.01078	76
14	4.01078	3.96165	3.91364	3.86671	3.82083	3.77595	3.73205	75
15	3.73205	3.68909	3.64705	3.60588	3.56557	3.52609	3.48741	74
16	3.48741	3.44951	3.41236	3.37594	3.34023	3.30521	3.27085	73
17	3.27085	3.23714	3.20406	3.17159	3.13972	3.10842	3.07768	72
18	3.07768	3.04749	3.01783	2.98869	2.96004	2.93189	2.90421	71
19	2.90421	2.87700	2.85023	2.82391	2.79802	2.77254	2.74748	70
20	2.74748	2.72281	2.69853	2.67462	2.65109	2.62791	2.60509	69
21	2.60509	2.58261	2.56046	2.53865	2.51715	2.49597	2.47509	68
22	2.47509	2.45451	2.43422	2.41421	2.39449	2.37504	2.35585	67
23	2.35585	2.33693	2.31826	2.29984	2.28167	2.26374	2.24604	66
24	2.24604	2.22857	2.21132	2.19430	2.17749	2.16090	2.14451	65
25	2.14451	2.12832	2.11233	2.09654	2.08094	2.06553	2.05030	64
26	2.05030	2.03526	2.02039	2.00569	1.99116	1.97680	1.96261	63
27	1.96261	1.94858	1.93470	1.92098	1.90741	1.89400	1.88073	62
28	1.88073	1.86760	1.85462	1.84177	1.82907	1.81649	1.80405	61
29	1.80405	1.79174	1.77955	1.76749	1.75556	1.74375	1.73205	60
30	1.73205	1.72047	1.70901	1.69766	1.68643	1.67530	1.66428	59
31	1.66428	1.65337	1.64256	1.63185	1.62125	1.61074	1.60033	58
32	1.60033	1.59002	1.57981	1.56969	1.55966	1.54972	1.53987	57
33	1.53987	1.53010	1.52043	1.51084	1.50133	1.49190	1.48256	56
34	1.48256	1.47330	1.46411	1.45501	1.44598	1.43703	1.42815	55
35	1.42815	1.41934	1.41061	1.40195	1.39336	1.38484	1.37638	54
36	1.37638	1.36800	1.35968	1.35142	1.34323	1.33511	1.32704	53
37	1.32704	1.31904	1.31110	1.30323	1.29541	1.28764	1.27994	52
38	1.27994	1.27230	1.26471	1.25717	1.24969	1.24227	1.23490	51
39	1.23490	1.22758	1.22031	1.21310	1.20593	1.19882	1.19175	50
40	1.19175	1.18474	1.17777	1.17085	1.16398	1.15715	1.15037	49
41	1.15037	1.14363	1.13694	1.13029	1.12369	1.11713	1.11061	48
42	1.11061	1.10414	1.09770	1.09131	1.08496	1.07864	1.07237	47
43	1.07237	1.06613	1.05994	1.05378	1.04766	1.04158	1.03553	46
44	1.03553	1.02952	1.02355	1.01761	1.01170	1.00583	1.00000	45
	60′	50′	40′	30′	20′	10′	0′	Degrees
	TANGENT							

Degrees	SECANTS							
	0′	10′	20′	30′	40′	50′	60′	
0	1.00000	1.00001	1.00002	1.00004	1.00007	1.00011	1.00015	89
1	1.00015	1.00021	1.00027	1.00034	1.00042	1.00051	1.00061	88
2	1.00061	1.00072	1.00083	1.00095	1.00108	1.00122	1.00137	87
3	1.00137	1.00153	1.00169	1.00187	1.00205	1.00224	1.00244	86
4	1.00244	1.00265	1.00287	1.00309	1.00333	1.00357	1.00382	85
5	1.00382	1.00408	1.00435	1.00463	1.00491	1.00521	1.00551	84
6	1.00551	1.00582	1.00614	1.00647	1.00681	1.00715	1.00751	83
7	1.00751	1.00787	1.00825	1.00863	1.00902	1.00942	1.00983	82
8	1.00983	1.01024	1.01067	1.01111	1.01155	1.01200	1.01247	81
9	1.01247	1.01294	1.01342	1.01391	1.01440	1.01491	1.01543	80
10	1.01543	1.01595	1.01649	1.01703	1.01758	1.01815	1.01872	79
11	1.01872	1.00930	1.01989	1.02049	1.02110	1.02171	1.02234	78
12	1.02234	1.02298	1.02362	1.02428	1.02494	1.02562	1.02630	77
13	1.02630	1.02700	1.02770	1.02842	1.02914	1.02987	1.03061	76
14	1.03061	1.03137	1.03213	1.03290	1.03368	1.03447	1.03528	75
15	1.03528	1.03609	1.03691	1.03774	1.03858	1.03944	1.04030	74
16	1.04030	1.04117	1.04206	1.04295	1.04385	1.04477	1.04569	73
17	1.04569	1.04663	1.04757	1.04853	1.04950	1.05047	1.05146	72
18	1.05146	1.05246	1.05347	1.05449	1.05552	1.05657	1.05762	71
19	1.05762	1.05869	1.05976	1.06085	1.06195	1.06306	1.06418	70
20	1.06418	1.06531	1.06645	1.06761	1.06878	1.06995	1.07115	69
21	1.07115	1.07235	1.07356	1.07479	1.07602	1.07727	1.07853	68
22	1.07853	1.07981	1.08109	1.08239	1.08370	1.08503	1.08636	67
23	1.08636	1.08771	1.08907	1.09044	1.09183	1.09323	1.09464	66
24	1.09464	1.09606	1.09750	1.09895	1.10041	1.10189	1.10338	65
25	1.10338	1.10488	1.10640	1.10793	1.10947	1.11103	1.11260	64
26	1.11260	1.11419	1.11579	1.11740	1.11903	1.12067	1.12233	63
27	1.12233	1.12400	1.12568	1.12738	1.12910	1.13083	1.13257	62
28	1.13257	1.13433	1.13610	1.13789	1.13970	1.14152	1.14335	61
29	1.14335	1.14521	1.14707	1.14896	1.15085	1.15277	1.15470	60
30	1.15470	1.15665	1.15861	1.16059	1.16259	1.16460	1.16663	59
31	1.16663	1.16868	1.17075	1.17283	1.17493	1.17704	1.17918	58
32	1.17918	1.18133	1.18350	1.18569	1.18790	1.19012	1.19236	57
33	1.19236	1.19463	1.19691	1.19920	1.20152	1.20386	1.20622	56
34	1.20622	1.20859	1.21099	1.21341	1.21584	1.21830	1.22077	55
35	1.22077	1.22327	1.22579	1.22833	1.23089	1.23347	1.23607	54
36	1.23607	1.23869	1.24134	1.24400	1.24669	1.24940	1.25214	53
37	1.25214	1.25489	1.25767	1.26047	1.26330	1.26615	1.26902	52
38	1.26902	1.27191	1.27483	1.27778	1.28075	1.28374	1.28676	51
39	1.28676	1.28980	1.29287	1.29597	1.29909	1.30223	1.30541	50
40	1.30541	1.30861	1.31183	1.31509	1.31837	1.32168	1.32501	49
41	1.32501	1.32838	1.33177	1.33519	1.33864	1.34212	1.34563	48
42	1.34563	1.34917	1.35274	1.35634	1.35997	1.36363	1.36733	47
43	1.36733	1.37105	1.37481	1.37860	1.38242	1.38628	1.39016	46
44	1.39016	1.39409	1.39804	1.40203	1.40606	1.41012	1.41421	45
	60′	50′	40′	30′	20′	10′	0′	Degrees
	COSECANTS							

Degrees	COSECANTS							
	0′	10′	20′	30′	40′	50′	60′	
0	∞	343.77516	171.88831	114.59301	85.94561	68.75736	57.29869	89
1	57.29869	49.11406	42.97571	38.20155	34.38232	31.25758	28.65371	88
2	28.65371	26.45051	24.56212	22.92559	21.49368	20.23028	19.10732	87
3	19.10732	18.10262	17.19843	16.38041	15.63679	14.95788	14.33559	86
4	14.33559	13.76312	13.23472	12.74550	12.29125	11.86837	11.47371	85
5	11.47371	11.10455	10.75849	10.43343	10.12752	9.83912	9.56677	84
6	9.56677	9.30917	9.06515	8.83367	8.61379	8.46466	8.20551	83
7	8.20551	8.01565	7.83443	7.66130	7.49571	7.33719	7.18530	82
8	7.18530	7.03962	6.89979	6.76547	6.63633	6.51208	6.39245	81
9	6.39245	6.27719	6.16607	6.05886	5.95536	5.85539	5.75877	80
10	5.75877	5.66533	5.57493	5.48740	5.40263	5.32049	5.24084	79
11	5.24084	5.16359	5.08863	5.01585	4.94517	4.87649	4.80973	78
12	4.80973	4.74482	4.68167	4.62023	4.56041	4.50216	4.44541	77
13	4.44541	4.39012	4.33622	4.28366	4.23239	4.18238	4.13357	76
14	4.13357	4.08591	4.03938	3.99393	3.94952	3.90613	3.86370	75
15	3.86370	3.82223	3.78166	3.74198	3.70315	3.66515	3.62796	74
16	3.62796	3.59154	3.55587	3.52094	3.48671	3.45317	3.42030	73
17	3.42030	3.38808	3.35649	3.32551	3.29512	3.26531	3.23607	72
18	3.23607	3.20737	3.17920	3.15155	3.12440	3.09774	3.07155	71
19	3.07155	3.04584	3.02057	2.99574	2 97135	2.94737	2.92380	70
20	2.92380	2.90063	2.87785	2.85545	2.83342	2.81175	2.79043	69
21	2.79043	2.76945	2.74881	2.72850	2.70851	2.68884	2.66947	68
22	2.66947	2.65040	2.63162	2.61313	2.59491	2.57698	2.55930	67
23	2.55930	2.54190	2.52474	2.50784	2.49119	2.47477	2.45859	66
24	2.45859	2.44264	2.42692	2.41142	2.39614	2.38107	2.36620	65
25	2.36620	2.35154	2.33708	2.32282	2.30875	2.29487	2.28117	64
26	2.28117	2.26766	2.25432	2.24116	2.22817	2.21535	2.20269	63
27	2.20269	2.19019	2.17786	2.16568	2.15366	2.14178	2.13005	62
28	2.13005	2.11847	2.10704	2.09574	2.08458	2.07356	2.06267	61
29	2.06267	2.05191	2.04128	2.03077	2.02039	2.01014	2.00000	60
30	2.00000	1.98998	1.98008	1.97029	1.96062	1.95106	1.94160	59
31	1.94160	1.93226	1.92302	1.91388	1.90485	1.89591	1.88709	58
32	1.88708	1.87834	1.86990	1.86116	1.85271	1.84435	1.83608	57
33	1.83608	1.82790	1.81981	1.81180	1.80388	1.79604	1.78829	56
34	1.78829	1.78062	1.77303	1 76552	1.75808	1.75073	1.74345	55
35	1.74345	1.73624	1.72911	1.72205	1.71506	1.70815	1.70130	54
36	1.70130	1.69452	1.68782	1.68117	1.67460	1.66809	1.66164	53
37	1.66164	1.65526	1.64894	1.64268	1.63648	1.63035	1.62427	52
38	1.62427	1.61825	1.61229	1.60639	1.60054	1.59475	1.58902	51
39	1.58902	1.58333	1.57771	1.57213	1.56661	1.56114	1.55572	50
40	1.55572	1.55036	1.54504	1.53977	1.53455	1.52938	1.52425	49
41	1.52425	1.51918	1.51415	1.50916	1.50422	1.49933	1.49448	48
42	1.49448	1.48967	1.48491	1.48019	1.47551	1.47087	1.46628	47
43	1.46628	1.46173	1.45721	1.45274	1.44831	1.44391	1.43956	46
44	1.43956	1.43524	1.43096	1.42672	1.42251	1.41835	1.41421	45
	60′	50′	40′	30′	20′	10′	0′	Degrees
	SECANTS							

SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, LOGARITHMS, RECIPROCALS, CIRCUMFERENCES AND CIRCULAR AREAS OF NOS. FROM 1 TO 1000

No.	Square	Cube	Sq. Root	Cu. Root	Log.	1000xRecip.	No. = Dia.	
							Circum.	Area
1	1	1	1.0000	1.0000	0.00000	1000.000	3.142	0.7854
2	4	8	1.4142	1.2599	0.30103	500.000	6.283	3.1416
3	9	27	1.7321	1.4422	0.47712	333.333	9.425	7.0686
4	16	64	2.0000	1.5874	0.60206	250.000	12.566	12.5664
5	25	125	2.2361	1.7100	0.69897	200.000	15.708	19.6350
6	36	216	2.4495	1.8171	0.77815	166.667	18.850	28.2743
7	49	343	2.6458	1.9129	0.84510	142.857	21.991	38.4845
8	64	512	2.8284	2.0000	0.90309	125.000	25.133	50.2655
9	81	729	3.0000	2.0801	0.95424	111.111	28.274	63.6173
10	100	1000	3.1623	2.1544	1.00000	100.000	31.416	78.5398
11	121	1331	3.3166	2.2240	1.04139	90.9091	34.558	95.0332
12	144	1728	3.4641	2.2894	1.07918	83.3333	37.699	113.097
13	169	2197	3.6056	2.3513	1.11394	76.9231	40.841	132.732
14	196	2744	3.7417	2.4101	1.14613	71.4286	43.982	153.938
15	225	3375	3.8730	2.4662	1.17609	66.6667	47.124	176.715
16	256	4096	4.0000	2.5198	1.20412	62.5000	50.265	201.062
17	289	4913	4.1231	2.5713	1.23045	58.8235	53.407	226.980
18	324	5832	4.2426	2.6207	1.25527	55.5556	56.549	254.469
19	361	6859	4.3589	2.6684	1.27875	52.6316	59.690	283.529
20	400	8000	4.4721	2.7144	1.30103	50.0000	62.832	314.159
21	441	9261	4.5826	2.7589	1.32222	47.6190	65.973	346.361
22	484	10648	4.6904	2.8020	1.34242	45.4545	69.115	380.133
23	529	12167	4.7958	2.8439	1.36173	43.4783	72.257	415.476
24	576	13824	4.8990	2.8845	1.38021	41.6667	75.398	452.389
25	625	15625	5.0000	2.9240	1.39794	40.0000	78.540	490.874
26	676	17576	5.0990	2.9625	1.41497	38.4615	81.681	530.929
27	729	19683	5.1962	3.0000	1.43136	37.0370	84.823	572.555
28	784	21952	5.2915	3.0366	1.44716	35.7143	87.965	615.752
29	841	24389	5.3852	3.0723	1.46240	34.4828	91.106	660.520
30	900	27000	5.4772	3.1072	1.47712	33.3333	94.248	706.858
31	961	29791	5.5678	3.1414	1.49136	32.2581	97.389	754.768
32	1024	32768	5.6569	3.1748	1.50515	31.2500	100.531	804.248
33	1089	35937	5.7446	3.2075	1.51851	30.3030	103.673	855.299
34	1156	39304	5.8310	3.2396	1.53148	29.4118	106.814	907.920
35	1225	42875	5.9161	3.2711	1.54407	28.5714	109.956	962.113
36	1296	46656	6.0000	3.3019	1.55630	27.7778	113.097	1017.88
37	1369	50653	6.0828	3.3322	1.56820	27.0270	116.239	1075.21
38	1444	54872	6.1644	3.3620	1.57978	26.3158	119.381	1134.11
39	1521	59319	6.2450	3.3912	1.59106	25.6410	122.522	1194.59
40	1600	64000	6.3246	3.4200	1.60206	25.0000	125.66	1256.64
41	1681	68921	6.4031	3.4482	1.61278	24.3902	128.81	1320.25
42	1764	74088	6.4807	3.4760	1.62325	23.8095	131.95	1385.44
43	1849	79507	6.5574	3.5034	1.63347	23.2558	135.09	1452.20
44	1936	85184	6.6332	3.5303	1.64345	22.7273	138.23	1520.53
45	2025	91125	6.7082	3.5569	1.65321	22.2222	141.37	1590.43
46	2116	97336	6.7823	3.5830	1.66276	21.7391	144.51	1661.90
47	2209	103823	6.8557	3.6088	1.67210	21.2766	147.65	1734.94
48	2304	110592	6.9282	3.6342	1.68124	20.8333	150.80	1809.56
49	2401	117649	7.0000	3.6593	1.69020	20.4082	153.94	1885.74

SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, LOGARITHMS, RECIPROCALS, CIRCUMFERENCES AND CIRCULAR AREAS OF NOS. FROM 1 TO 1000

No.	Square	Cube	Sq. Root	Cu. Root	Log.	1000xRecip.	No. = Dia.	
							Circum.	Area
50	2500	125000	7.0711	3.6840	1.69897	20.0000	157.08	1963.50
51	2601	132651	7.1414	3.7084	1.70757	19.6078	160.22	2042.82
52	2704	140608	7.2111	3.7325	1.71600	19.2308	163.36	2123.72
53	2809	148877	7.2801	3.7563	1.72428	18.8679	166.50	2206.18
54	2916	157464	7.3485	3.7798	1.73239	18.5185	169.65	2290.22
55	3025	166375	7.4162	3.8030	1.74036	18.1818	172.79	2375.83
56	3136	175616	7.4833	3.8259	1.74819	17.8571	175.93	2463.01
57	3249	185193	7.5498	3.8485	1.75587	17.5439	179.07	2551.76
58	3364	195112	7.6158	3.8709	1.76343	17.2414	182.21	2642.08
59	3481	205379	7.6811	3.8930	1.77085	16.9492	185.35	2733.97
60	3600	216000	7.7460	3.9149	1.77815	16.6667	188.50	2827.43
61	3721	226981	7.8102	3.9365	1.78533	16.3934	191.64	2922.47
62	3844	238328	7.8740	3.9579	1.79239	16.1290	194.78	3019.07
63	3969	250047	7.9373	3.9791	1.79934	15.8730	197.92	3117.25
64	4096	262144	8.0000	4.0000	1.80618	15.6250	201.06	3216.99
65	4225	274625	8.0623	4.0207	1.81291	15.3846	204.20	3318.31
66	4356	287496	8.1240	4.0412	1.81954	15.1515	207.35	3421.19
67	4489	300763	8.1854	4.0615	1.82607	14.9254	210.49	3525.65
68	4624	314432	8.2462	4.0817	1.83251	14.7059	213.63	3631.68
69	4761	328509	8.3066	4.1016	1.83885	14.4928	216.77	3739.28
70	4900	343000	8.3666	4.1213	1.84510	14.2857	219.91	3848.45
71	5041	357911	8.4261	4.1408	1.85126	14.0845	223.05	3959.19
72	5184	373248	8.4853	4.1602	1.85733	13.8889	226.19	4071.50
73	5329	389017	8.5440	4.1793	1.86332	13.6986	229.34	4185.39
74	5476	405224	8.6023	4.1983	1.86923	13.5135	232.48	4300.84
75	5625	421875	8.6603	4.2172	1.87506	13.3333	235.62	4417.86
76	5776	438976	8.7178	4.2358	1.88081	13.1579	238.76	4536.46
77	5929	456533	8.7750	4.2543	1.88649	12.9870	241.90	4656.63
78	6084	474552	8.8318	4.2727	1.89209	12.8205	245.04	4778.36
79	6241	493039	8.8882	4.2908	1.89763	12.6582	248.19	4901.67
80	6400	512000	8.9443	4.3089	1.90309	12.5000	251.33	5026.55
81	6561	531441	9.0000	4.3267	1.90849	12.3457	254.47	5153.00
82	6724	551368	9.0554	4.3445	1.91381	12.1951	257.61	5281.02
83	6889	571787	9.1104	4.3621	1.91908	12.0482	260.75	5410.61
84	7056	592704	9.1652	4.3795	1.92428	11.9048	263.89	5541.77
85	7225	614125	9.2195	4.3968	1.92942	11.7647	267.04	5674.50
86	7396	636056	9.2736	4.4140	1.93450	11.6279	270.18	5808.80
87	7569	658503	9.3274	4.4310	1.93952	11.4943	273.32	5944.68
88	7744	681472	9.3808	4.4480	1.94448	11.3636	276.46	6082.12
89	7921	704969	9.4340	4.4647	1.94939	11.2360	279.60	6221.14
90	8100	729000	9.4868	4.4814	1.95424	11.1111	282.74	6361.73
91	8281	753571	9.5394	4.4979	1.95904	10.9890	285.88	6503.88
92	8464	778688	9.5917	4.5144	1.96379	10.8696	289.03	6647.61
93	8649	804357	9.6437	4.5307	1.96848	10.7527	292.17	6792.91
94	8836	830584	9.6954	4.5468	1.97313	10.6383	295.31	6939.78
95	9025	857375	9.7468	4.5629	1.97772	10.5263	298.45	7088.22
96	9216	884736	9.7980	4.5789	1.98227	10.4167	301.59	7238.23
97	9409	912673	9.8489	4.5947	1.98677	10.3093	304.73	7389.81
98	9604	941192	9.8995	4.6104	1.99123	10.2041	307.88	7542.96
99	9801	970299	9.9499	4.6261	1.99564	10.1010	311.02	7697.69

SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, LOGARITHMS, RECIPROCALS, CIRCUMFERENCES AND CIRCULAR AREAS OF NOS. FROM 1 TO 1000

No.	Square	Cube	Sq. Root	Cu. Root	Log.	1000xRecip.	No. = Dia.	
							Circum.	Area
100	10000	1000000	10.0000	4.6416	2.00000	10.0000	314.16	7853.98
101	10201	1030301	10.0499	4.6570	2.00432	9.90099	317.30	8011.85
102	10404	1061208	10.0995	4.6723	2.00860	9.80392	320.44	8171.28
103	10609	1092727	10.1489	4.6875	2.01284	9.70874	323.58	8332.29
104	10816	1124864	10.1980	4.7027	2.01703	9.61538	326.73	8494.87
105	11025	1157625	10.2470	4.7177	2.02119	9.52381	329.87	8659.01
106	11236	1191016	10.2956	4.7326	2.02531	9.43396	333.01	8824.73
107	11449	1225043	10.3441	4.7475	2.02938	9.34579	336.15	8992.02
108	11664	1259712	10.3923	4.7622	2.03342	9.25926	339.29	9160.88
109	11881	1295029	10.4403	4.7769	2.03743	9.17431	342.43	9331.32
110	12100	1331000	10.4881	4.7914	2.04139	9.09091	345.58	9503.32
111	12321	1367631	10.5357	4.8059	2.04532	9.00901	348.72	9676.89
112	12544	1404928	10.5830	4.8203	2.04922	8.92857	351.86	9852.03
113	12769	1442897	10.6301	4.8346	2.05308	8.84956	355.00	10028.7
114	12996	1481544	10.6771	4.8488	2.05690	8.77193	358.14	10207.0
115	13225	1520875	10.7238	4.8629	2.06070	8.69565	361.28	10386.9
116	13456	1560896	10.7703	4.8770	2.06446	8.62069	364.42	10568.3
117	13689	1601613	10.8167	4.8910	2.06819	8.54701	367.57	10751.3
118	13924	1643032	10.8628	4.9049	2.07188	8.47458	370.71	10935.9
119	14161	1685159	10.9087	4.9187	2.07555	8.40336	373.85	11122.0
120	14400	1728000	10.9545	4.9324	2.07918	8.33333	376.99	11309.7
121	14641	1771561	11.0000	4.9461	2.08279	8.26446	380.13	11499.0
122	14884	1815848	11.0454	4.9597	2.08636	8.19672	383.27	11689.9
123	15129	1860867	11.0905	4.9732	2.08991	8.13008	386.42	11882.3
124	15376	1906624	11.1355	4.9866	2.09342	8.06452	389.56	12076.3
125	15625	1953125	11.1803	5.0000	2.09691	8.00000	392.70	12271.8
126	15876	2000376	11.2250	5.0133	2.10037	7.93651	395.84	12469.0
127	16129	2048383	11.2694	5.0265	2.10380	7.87402	398.98	12667.7
128	16384	2097152	11.3137	5.0397	2.10721	7.81250	402.12	12868.0
129	16641	2146689	11.3578	5.0528	2.11059	7.75194	405.27	13069.8
130	16900	2197000	11.4018	5.0658	2.11394	7.69231	408.41	13273.2
131	17161	2248091	11.4455	5.0788	2.11727	7.63359	411.55	13478.2
132	17424	2299968	11.4891	5.0916	2.12057	7.57576	414.69	13684.8
133	17689	2352637	11.5326	5.1045	2.12385	7.51880	417.83	13892.9
134	17956	2406104	11.5758	5.1172	2.12710	7.46269	420.97	14102.6
135	18225	2460375	11.6190	5.1299	2.13033	7.40741	424.12	14313.9
136	18496	2515456	11.6619	5.1426	2,13354	7.35294	427.26	14526.7
137	18769	2571353	11.7047	5.1551	2.13672	7.29927	430.40	14741.1
138	19044	2628072	11.7473	5.1676	2.13988	7.24638	433.54	14957.1
139	19321	2685619	11.7898	5.1801	2.14301	7.19424	436.68	15174.7
140	19600	2744000	11.8322	5.1925	2.14613	7.14286	439.82	15393.8
141	19881	2803221	11.8743	5.2048	2.14922	7.09220	442.96	15614.5
142	20164	2863288	11.9164	5.2171	2.15229	7.04255	446.11	15836.8
143	20449	2924207	11.9583	5.2293	2.15534	6.99301	449.25	16060.6
144	20736	2985984	12.0000	5.2415	2.15836	6.94444	452.39	16286.0
145	21025	3048625	12.0416	5.2536	2.16137	6.89655	455.53	16513.0
146	21316	3112136	12.0830	5.2656	2.16435	6.84932	458.67	16741.5
147	21609	3176523	12.1244	5.2776	2.16732	6.80272	461.81	16971.7
148	21904	3241792	12.1655	5.2896	2.17026	6.75676	464.96	17203.4
149	22201	3307949	12.2066	5.3015	2.17319	6.71141	468.10	17436.6

SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, LOGARITHMS, RECIPROCALS, CIRCUMFERENCES AND CIRCULAR AREAS OF NOS. FROM 1 TO 1000

No.	Square	Cube	Sq. Root	Cu. Root	Log.	1000xRecip.	No. = Dia.	
							Circum.	Area
150	22500	3375000	12.2474	5.3133	2.17609	6.66667	471.24	17671.5
151	22801	3442951	12.2882	5.3251	2.17898	6.62252	474.38	17907.9
152	23104	3511808	12.3288	5.3368	2.18184	6.57895	477.52	18145.8
153	23409	3581577	12.3693	5.3485	2.18469	6.53595	480.66	18385.4
154	23716	3652264	12.4097	5.3601	2.18752	6.49351	483.81	18626.5
155	24025	3723875	12.4499	5.3717	2.19033	6.45161	486.95	18869.2
156	24336	3796416	12.4900	5.3832	2.19312	6.41026	490.09	19113.4
157	24649	3869893	12.5300	5.3947	2.19590	6.36943	493.23	19359.3
158	24964	3944312	12.5698	5.4061	2.19866	6.32911	496.37	19606.7
159	25281	4019679	12.6095	5.4175	2.20140	6.28931	499.51	19855.7
160	25600	4096000	12.6491	5.4288	2.20412	6.25000	502.65	20106.2
161	25921	4173281	12.6886	5.4401	2.20683	6.21118	505.80	20358.3
162	26244	4251528	12.7279	5.4514	2.20952	6.17284	508.94	20612.0
163	26569	4330747	12.7671	5.4626	2.21219	6.13497	512.08	20867.2
164	26896	4410944	12.8062	5.4737	2.21484	6.09756	515.22	21124.1
165	27225	4492125	12.8452	5.4848	2.21748	6.06061	518.36	21382.5
166	27556	4574296	12.8841	5.4959	2.22011	6.02410	521.50	21642.4
167	27889	4657463	12.9228	5.5069	2.22272	5.98802	524.65	21904.0
168	28224	4741632	12.9615	5.5178	2.22531	5.95238	527.79	22167.1
169	28561	4826809	13.0000	5.5288	2.22789	5.91716	530.93	22431.8
170	28900	4913000	13.0384	5.5397	2.23045	5.88235	534.07	22698.0
171	29241	5000211	13.0767	5.5505	2.23300	5.84795	537.21	22965.8
172	29584	5088448	13.1149	5.5613	2.23553	5.81395	540.35	23235.2
173	29929	5177717	13.1529	5.5721	2.23805	5.78035	543.50	23506.2
174	30276	5268024	13.1909	5.5828	2.24055	5.74713	546.64	23778.7
175	30625	5359375	13.2288	5.5934	2.24304	5.71429	549.78	24052.8
176	30976	5451776	13.2665	5.6041	2.24551	5.68182	552.92	24328.5
177	31329	5545233	13.3041	5.6147	2.24797	5.64972	556.06	24605.7
178	31684	5639752	13.3417	5.6252	2.25042	5.61798	559.20	24884.6
179	32041	5735339	13.3791	5.6357	2.25285	5.58659	562.35	25164.9
180	32400	5832000	13.4164	5.6462	2.25527	5.55556	565.49	25446.9
181	32761	5929741	13.4536	5.6567	2.25768	5.52486	568.63	25730.4
182	33124	6028568	13.4907	5.6671	2.26007	5.49451	571.77	26015.5
183	33489	6128487	13.5277	5.6774	2.26245	5.46448	574.91	26302.2
184	33856	6229504	13.5647	5.6877	2.26482	5.43478	578.05	26590.4
185	34225	6331625	13.6015	5.6980	2.26717	5.40541	581.19	26880.3
186	34596	6434856	13.6382	5.7083	2.26951	5.37634	584.34	27171.6
187	34969	6539203	13.6748	5.7185	2.27184	5.34759	587.48	27464.6
188	35344	6644672	13.7113	5.7287	2.27416	5.31915	590.62	27759.1
189	35721	6751269	13.7477	5.7388	2.27646	5.29101	593.76	28055.2
190	36100	6859000	13.7840	5.7489	2.27875	5.26316	596.90	28352.9
191	36481	6967871	13.8203	5.7590	2.28103	5.23560	600.04	28652.1
192	36864	7077888	13.8564	5.7690	2.28330	5.20833	603.19	28952.9
193	37249	7189057	13.8924	5.7790	2.28556	5.18135	606.33	29255.3
194	37636	7301384	13.9284	5.7890	2.28780	5.15464	609.47	29559.2
195	38025	7414875	13.9642	5.7989	2.29003	5.12821	612.61	29864.8
196	38416	7529536	14.0000	5.8088	2.29226	5.10204	615.75	30171.9
197	38809	7645373	14.0357	5.8186	2.29447	5.07614	618.89	30480.5
198	39204	7762392	14.0712	5.8285	2.29667	5.05051	622.04	30790.7
199	39601	7880599	14.1067	5.8383	2.29885	5.02513	625.18	31102.6

SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, LOGARITHMS, RECIPROCALS, CIRCUMFERENCES AND CIRCULAR AREAS OF NOS. FROM 1 TO 1000

No.	Square	Cube	Sq. Root	Cu. Root	Log.	1000xRecip.	No. = Dia.	
							Circum.	Area
200	40000	8000000	14.1421	5.8480	2.30103	5.00000	628.32	31415.9
201	40401	8120601	14.1774	5.8578	2.30320	4.97512	631.46	31730.9
202	40804	8242408	14.2127	5.8675	2.30535	4.95050	634.60	32047.4
203	41209	8365427	14.2478	5.8771	2.30750	4.92611	637.74	32365.5
204	41616	8489664	14.2829	5.8868	2.30963	4.90196	640.89	32685.1
205	42025	8615125	14.3178	5.8964	2.31175	4.87805	644.03	33006.4
206	42436	8741816	14.3527	5.9059	2.31387	4.85437	647.17	33329.2
207	42849	8869743	14.3875	5.9155	2.31597	4.83092	650.31	33653.5
208	43264	8998912	14.4222	5.9250	2.31806	4.80769	653.45	33979.5
209	43681	9129329	14.4568	5.9345	2.32015	4.78469	656.59	34307.0
210	44100	9261000	14.4914	5.9439	2.32222	4.76190	659.73	34636.1
211	44521	9393931	14.5258	5.9533	2.32428	4.73934	662.88	34966.7
212	44944	9528128	14.5602	5.9627	2.32634	4.71698	666.02	35298.9
213	45369	9663597	14.5945	5.9721	2.32838	4.69484	669.16	35632.7
214	45796	9800344	14.6287	5.9814	2.33041	4.67290	672.30	35968.1
215	46225	9938375	14.6629	5.9907	2.33244	4.65116	675.44	36305.0
216	46656	10077696	14.6969	6.0000	2.33445	4.62963	678.58	36643.5
217	47089	10218313	14.7309	6.0092	2.33646	4.60829	681.73	36983.6
218	47524	10360232	14.7648	6.0185	2.33846	4.58716	684.87	37325.3
219	47961	10503459	14.7986	6.0277	2.34044	4.56621	688.01	37668.5
220	48400	10648000	14.8324	6.0368	2.34242	4.54545	691.15	38013.3
221	48841	10793861	14.8661	6.0459	2.34439	4.52489	694.29	38359.6
222	49284	10941048	14.8997	6.0550	2.34635	4.50450	697.43	38707.6
223	49729	11089567	14.9332	6.0641	2.34830	4.48431	700.58	39057.1
224	50176	11239424	14.9666	6.0732	2.35025	4.46429	703.72	39408.1
225	50625	11390625	15.0000	6.0822	2.35218	4.44444	706.86	39760.8
226	51076	11543176	15.0333	6.0912	2.35411	4.42478	710.00	40115.0
227	51529	11697083	15.0665	6.1002	2.35603	4.40529	713.14	40470.8
228	51984	11852352	15.0997	6.1091	2.35793	4.38596	716.28	40828.1
229	52441	12008989	15.1327	6.1180	2.35984	4.36681	719.42	41187.1
230	52900	12167000	15.1658	6.1269	2.36173	4.34783	722.57	41547.6
231	53361	12326391	15.1987	6.1358	2.36361	4.32900	725.71	41909.6
232	53824	12487168	15.2315	6.1446	2.36549	4.31034	728.85	42273.3
233	54289	12649337	15.2643	6.1534	2.36736	4.29185	731.99	42638.5
234	54756	12812904	15.2971	6.1622	2.36922	4.27350	735.13	43005.3
235	55225	12977875	15.3297	6.1710	2.37107	4.25532	738.27	43373.6
236	55696	13144256	15.3623	6.1797	2.37291	4.23729	741.42	43743.5
237	56169	13312053	15.3948	6.1885	2.37475	4.21941	744.56	44115.0
238	56644	13481272	15.4272	6.1972	2.37658	4.20168	747.70	44488.1
239	57121	13651919	15.4596	6.2058	2.37840	4.18410	750.84	44862.7
240	57600	13824000	15.4919	6.2145	2.38021	4.16667	753.98	45238.9
241	58081	13997521	15.5242	6.2231	2.38202	4.14938	757.12	45616.7
242	58564	14172488	15.5563	6.2317	2.38382	4.13223	760.27	45996.1
243	59049	14348907	15.5885	6.2403	2.38561	4.11523	763.41	46377.0
244	59536	14526784	15.6205	6.2488	2.38739	4.09836	766.55	46759.5
245	60025	14706125	15.6525	6.2573	2.38917	4.08163	769.69	47143.5
246	60516	14886936	15.6844	6.2658	2.39094	4.06504	772.83	47529.2
247	61009	15069223	15.7162	6.2743	2.39270	4.04858	775.97	47916.4
248	61504	15252992	15.7480	6.2828	2.39445	4.03226	779.12	48305.1
249	62001	15438249	15.7797	6.2912	2.39620	4.01606	782.26	48695.5

SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, LOGARITHMS, RECIPROCALS, CIRCUMFERENCES AND CIRCULAR AREAS OF NOS. FROM 1 TO 1000

No.	Square	Cube	Sq. Root	Cu. Root	Log.	1000xRecip.	No. = Dia.	
							Circum.	Area
250	62500	15625000	15.8114	6.2996	2.39794	4.00000	785.40	49087.4
251	63001	15813251	15.8430	6.3080	2.39967	3.98406	788.54	49480.9
252	63504	16003008	15.8745	6.3164	2.40140	3.96825	791.68	49875.9
253	64009	16194277	15.9060	6.3247	2.40312	3.95257	794.82	50272.6
254	64516	16387064	15.9374	6.3330	2.40483	3.93701	797.96	50670.7
255	65025	16581375	15.9687	6.3413	2.40654	3.92157	801.11	51070.5
256	65536	16777216	16.0000	6.3496	2.40824	3.90625	804.25	51471.9
257	66049	16974593	16.0312	6.3579	2.40993	3.89105	807.39	51874.8
258	66564	17173512	16.0624	6.3661	2.41162	3.87597	810.53	52279.2
259	67081	17373979	16.0935	6.3743	2.41330	3.86100	813.67	52685.3
260	67600	17576000	16.1245	6.3825	2.41497	3.84615	816.81	53092.9
261	68121	17779581	16.1555	6.3907	2.41664	3.83142	819.96	53502.1
262	68644	17984728	16.1864	6.3988	2.41830	3.81679	823.10	53912.9
263	69169	18191447	16.2173	6.4070	2.41996	3.80228	826.24	54325.2
264	69696	18399744	16.2481	6.4151	2.42160	3.78788	829.38	54739.1
265	70225	18609625	16.2788	6.4232	2.42325	3.77358	832.52	55154.6
266	70756	18821096	16.3095	6.4312	2.42488	3.75940	835.66	55571.6
267	71289	19034163	16.3401	6.4393	2.42651	3.74532	838.81	55990.3
268	71824	19248832	16.3707	6.4473	2.42813	3.73134	841.95	56410.4
269	72361	19465109	16.4012	6.4553	2.42975	3.71747	845.09	56832.2
270	72900	19683000	16.4317	6.4633	2.43136	3.70370	848.23	57255.5
271	73441	19902511	16.4621	6.4713	2.43297	3.69004	851.37	57680.4
272	73984	20123648	16.4924	6.4792	2.43457	3.67647	854.51	58106.9
273	74529	20346417	16.5227	6.4872	2.43616	3.66300	857.66	58534.9
274	75076	20570824	16.5529	6.4951	2.43775	3.64964	860.80	58964.6
275	75625	20796875	16.5831	6.5030	2.43933	3.63636	863.94	59395.7
276	76176	21024576	16.6132	6.5108	2.44091	3.62319	867.08	59828.5
277	76729	21253933	16.6433	6.5187	2.44248	3.61011	870.22	60262.8
278	77284	21484952	16.6733	6.5265	2.44404	3.59712	873.36	60698.7
279	77841	21717639	16.7033	6.5343	2.44560	3.58423	876.50	61136.2
280	78400	21952000	16.7332	6.5421	2.44716	3.57143	879.65	61575.2
281	78961	22188041	16.7631	6.5499	2.44871	3.55872	882.79	62015.8
282	79524	22425768	16.7929	6.5577	2.45025	3.54610	885.93	62458.0
283	80089	22665187	16.8226	6.5654	2.45179	3.53357	889.07	62901.8
284	80656	22906304	16.8523	6.5731	2.45332	3.52113	892.21	63347.1
285	81225	23149125	16.8819	6.5808	2.45484	3.50877	895.35	63794.0
286	81796	23393656	16.9115	6.5885	2.45637	3.49650	898.50	64242.4
287	82369	23639903	16.9411	6.5962	2.45788	3.48432	901.64	64692.5
288	82944	23887872	16.9706	6.6039	2.45939	3.47222	904.78	65144.1
289	83521	24137569	17.0000	6.6115	2.46090	3.46021	907.92	65597.2
290	84100	24389000	17.0294	6.6191	2.46240	3.44828	911.06	66052.0
291	84681	24642171	17.0587	6.6267	2.46389	3.43643	914.20	66508.3
292	85264	24897088	17.0880	6.6343	2.46538	3.42466	917.35	66966.2
293	85849	25153757	17.1172	6.6419	2.46687	3.41297	920.49	67425.6
294	86436	25412184	17.1464	6.6494	2.46835	3.40136	923.63	67886.7
295	87025	25672375	17.1756	6.6569	2.46982	3.38983	926.77	68349.3
296	87616	25934336	17.2047	6.6644	2.47129	3.37838	929.91	68813.5
297	88209	26198073	17.2337	6.6719	2.47276	3.36700	933.05	69279.2
298	88804	26463592	17.2627	6.6794	2.47422	3.35570	936.19	69746.5
299	89401	26730899	17.2916	6.6869	2.47567	3.34448	939.34	70215.4

SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, LOGARITHMS, RECIPROCALS, CIRCUMFERENCES AND CIRCULAR AREAS OF NOS. FROM 1 TO 1000

No.	Square	Cube	Sq. Root	Cu. Root	Log.	1000xRecip.	No. = Dia.	
							Circum.	Area
300	90000	27000000	17.3205	6.6943	2.47712	3.33333	942.48	70685.8
301	90601	27270901	17.3494	6.7018	2.47857	3.32226	945.62	71157.9
302	91204	27543608	17.3781	6.7092	2.48001	3.31126	948.76	71631.5
303	91809	27818127	17.4069	6.7166	2.48144	3.30033	951.90	72106.6
304	92416	28094464	17.4356	6.7240	2.48287	3.28947	955.04	72583.4
305	93025	28372625	17.4642	6.7313	2.48430	3.27869	958.19	73061.7
306	93636	28652616	17.4929	6.7387	2.48572	3.26797	961.33	73541.5
307	94249	28934443	17.5214	6.7460	2.48714	3.25733	964.47	74023.0
308	94864	29218112	17.5499	6.7533	2.48855	3.24675	967.61	74506.0
309	95481	29503629	17.5784	6.7606	2.48996	3.23625	970.75	74990.6
310	96100	29791000	17.6068	6.7679	2.49136	3.22581	973.89	75476.8
311	96721	30080231	17.6352	6.7752	2.49276	3.21543	977.04	75964.5
312	97344	30371328	17.6635	6.7824	2.49415	3.20513	980.18	76453.8
313	97969	30664297	17.6918	6.7897	2.49554	3.19489	983.32	76944.7
314	98596	30959144	17.7200	6.7969	2.49693	3.18471	986.46	77437.1
315	99225	31255875	17.7482	6.8041	2.49831	3.17460	989.60	77931.1
316	99856	31554496	17.7764	6.8113	2.49969	3.16456	992.74	78426.7
317	100489	31855013	17.8045	6.8185	2.50106	3.15457	995.88	78923.9
318	101124	32157432	17.8326	6.8256	2.50243	3.14465	999.03	79422 6
319	101761	32461759	17.8606	6.8328	2.50379	3.13480	1002.2	79922.9
320	102400	32768000	17.8885	6.8399	2.50515	3.12500	1005.3	80424.8
321	103041	33076161	17.9165	6.8470	2.50651	3.11527	1008.5	80928.2
322	103684	33386248	17.9444	6.8541	2.50786	3.10559	1011.6	81433.2
323	104329	33698267	17.9722	6.8612	2.50920	3.09598	1014.7	81939.8
324	104976	34012224	18.0000	6.8683	2.51055	3.08642	1017.9	82448.0
325	105625	34328125	18.0278	6.8753	2.51188	3.07692	1021.0	82957.7
326	106276	34645976	18.0555	6.8824	2.51322	3.06749	1024.2	83469.0
327	106929	34965783	18.0831	6.8894	2.51455	3.05810	1027.3	83981.8
328	107584	35287552	18.1108	6.8964	2.51587	3.04878	1030.4	84496.3
329	108241	35611289	18.1384	6.9034	2.51720	3.03951	1033.6	85012.3
330	108900	35937000	18.1659	6.9104	2.51851	3.03030	1036.7	85529.9
331	109561	36264691	18.1934	6.9174	2.51983	3.02115	1039.9	86049.0
332	110224	36594368	18.2209	6.9244	2.52114	3.01205	1043.0	86569.7
333	110889	36926037	18.2483	6.9313	2.52244	3.00300	1046.2	87092.0
334	111556	37259704	18.2757	6.9382	2.52375	2.99401	1049.3	87615.9
335	112225	37595375	18.3030	6.9451	2.52504	2.98507	1052.4	88141.3
336	112896	37933056	18.3303	6.9521	2.52634	2.97619	1055.6	88668.3
337	113569	38272753	18.3576	6.9589	2.52763	2.96736	1058.7	89196.9
338	114244	38614472	18.3848	6.9658	2.52892	2.95858	1061.9	89727.0
339	114921	38958219	18.4120	6.9727	2.53020	2.94985	1065.0	90258.7
340	115600	39304000	18.4391	6.9795	2.53148	2.94118	1068.1	90792.0
341	116281	39651821	18.1662	6.9864	2.53275	2.93255	1071.3	91326.9
342	116964	40001688	18.4932	6.9932	2.53403	2.92398	1074.4	91863.3
343	117649	40353607	18.5203	7.0000	2.53529	2.91545	1077.6	92401.3
344	118336	40707584	18.5472	7.0068	2.53656	2.90698	1080.7	92940.9
345	119025	41063625	18.5742	7.0136	2.53782	2.89855	1083.8	93482.0
346	119716	41421736	18.6011	7.0203	2.53908	2.89017	1087.0	94024.7
347	120409	41781923	18.6279	7.0271	2.54033	2.88184	1090.1	94569.0
348	121104	42144192	18.6548	7.0338	2.54158	2.87356	1093.3	95114.9
349	121801	42508549	18.6815	7.0406	2.54283	2.86533	1096.4	95662.3

SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, LOGARITHMS, RECIPROCALS, CIRCUMFERENCES AND CIRCULAR AREAS OF NOS. FROM 1 TO 1000

No.	Square	Cube	Sq. Root	Cu. Root	Log.	1000xRecip.	No. = Dia.	
							Circum.	Area
350	122500	42875000	18.7083	7.0473	2.54407	2.85714	1099.6	96211.3
351	123201	43243551	18.7350	7.0540	2.54531	2.84900	1102.7	96761.8
352	123904	43614208	18.7617	7.0607	2.54654	2.84091	1105.8	97314.0
353	124609	43986977	18.7883	7.0674	2.54777	2.83286	1109.0	97867.7
354	125316	44361864	18.8149	7.0740	2.54900	2.82486	1112.1	98423.0
355	126025	44738875	18.8414	7.0807	2.55023	2.81690	1115.3	98979.8
356	126736	45118016	18.8680	7.0873	2.55145	2.80899	1118.4	99538.2
357	127449	45499293	18.8944	7.0940	2.55267	2.80112	1121.5	100098
358	128164	45882712	18.9209	7.1006	2.55388	2.79330	1124.7	100660
359	128881	46268279	18.9473	7.1072	2.55509	2.78552	1127.8	101223
360	129600	46656000	18.9737	7.1138	2.55630	2.77778	1131.0	101788
361	130321	47045881	19.0000	7.1204	2.55751	2.77008	1134.1	102354
362	131044	47437928	19.0263	7.1269	2.55871	2.76243	1137.3	102922
363	131769	47832147	19.0526	7.1335	2.55991	2.75482	1140.4	103491
364	132496	48228544	19.0788	7.1400	2.56110	2.74725	1143.5	104062
365	133225	48627125	19.1050	7.1466	2.56229	2.73973	1146.7	104635
366	133956	49027896	19.1311	7.1531	2.56348	2.73224	1149.8	105209
367	134689	49430863	19.1572	7.1596	2.56467	2.72480	1153.0	105785
368	135424	49836032	19.1833	7.1661	2.56585	2.71739	1156.1	106362
369	136161	50243409	19.2094	7.1726	2.56703	2.71003	1159.2	106941
370	136900	50653000	19.2354	7.1791	2.56820	2.70270	1162.4	107521
371	137641	51064811	19.2614	7.1855	2.56937	2.69542	1165.5	108103
372	138384	51478848	19.2873	7.1920	2.57054	2.68817	1168.7	108687
373	139129	51895117	19.3132	7.1984	2.57171	2.68097	1171.8	109272
374	139876	52313624	19.3391	7.2048	2.57287	2.67380	1175.0	109858
375	140625	52734375	19.3649	7.2112	2.57403	2.66667	1178.1	110447
376	141376	53157376	19.3907	7.2177	2.57519	2.65957	1181.2	111036
377	142129	53582633	19.4165	7.2240	2.57634	2.65252	1184.4	111628
378	142884	54010152	19.4422	7.2304	2.57749	2.64550	1187.5	112221
379	143641	54439939	19.4679	7.2368	2.57864	2.63852	1190.7	112815
380	144400	54872000	19.4936	7.2432	2.57978	2.63158	1193.8	113411
381	145161	55306341	19.5192	7.2495	2.58093	2.62467	1196.9	114009
382	145924	55742968	19.5448	7.2558	2.58206	2.61780	1200.1	114608
383	146689	56181887	19.5704	7.2622	2.58320	2.61097	1203.2	115209
384	147456	56623104	19.5959	7.2685	2.58433	2.60417	1206.4	115812
385	148225	57066625	19.6214	7.2748	2.58546	2.59740	1209.5	116416
386	148996	57512456	19.6469	7.2811	2.58659	2.59067	1212.7	117021
387	149769	57960603	19.6723	7.2874	2.58771	2.58398	1215.8	117628
388	150544	58411072	19.6977	7.2936	2.58883	2.57732	1218.9	118237
389	151321	58863869	19.7231	7.2999	2.58995	2.57069	1221.1	118847
390	152100	59319000	19.7484	7.3061	2.59106	2.56410	1225.2	119459
391	152881	59776471	19.7737	7.3124	2.59218	2.55755	1228.4	120072
392	153664	60236288	19.7990	7.3186	2.59329	2.55102	1231.5	120687
393	154449	60698457	19.8242	7.3248	2.59439	2.54453	1234.6	121304
394	155236	61162984	19.8494	7.3310	2.59550	2.53807	1237.8	121922
395	156025	61629875	19.8746	7.3372	2.59660	2.53165	1240.9	122542
396	156816	62099136	19.8997	7.3434	2.59770	2.52525	1244.1	123163
397	157609	62570773	19.9249	7.3496	2.59879	2.51889	1247.2	123786
398	158404	63044792	19.9499	7.3558	2.59988	2.51256	1250.4	124410
399	159201	63521199	19.9750	7.3619	2.60097	2.50627	1253.5	125036

SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, LOGARITHMS, RECIPROCALS, CIRCUMFERENCES AND CIRCULAR AREAS OF NOS. FROM 1 TO 1000

No.	Square	Cube	Sq. Root	Cu. Root	Log.	1000xRecip.	No. = Dia.	
							Circum.	Area
400	160000	64000000	20.0000	7.3681	2.60206	2.50000	1256.6	125664
401	160801	64481201	20.0250	7.3742	2.60314	2.49377	1259.8	126293
402	161604	64964808	20.0499	7.3803	2.60423	2.48756	1262.9	126923
403	162409	65450827	20.0749	7.3864	2.60531	2.48139	1266.1	127556
404	163216	65939264	20.0998	7.3925	2.60638	2.47525	1269.2	128190
405	164025	66430125	20.1246	7.3986	2.60746	2.46914	1272.3	128825
406	164836	66923416	20.1494	7.4047	2.60853	2.46305	1275.5	129462
407	165649	67419143	20.1742	7.4108	2.60959	2.45700	1278.6	130100
408	166464	67917312	20.1990	7.4169	2.61066	2.45098	1281.8	130741
409	167281	68417929	20.2237	7.4229	2.61172	2.44499	1284.9	131382
410	168100	68921000	20.2485	7.4290	2.61278	2.43902	1288.1	132025
411	168921	69426531	20.2731	7.4350	2.61384	2.43309	1291.2	132670
412	169744	69934528	20.2978	7.4410	2.61490	2.42718	1294.3	133317
413	170569	70444997	20.3224	7.4470	2.61595	2.42131	1297.5	133965
414	171396	70957944	20.3470	7.4530	2.61700	2.41546	1300.6	134614
415	172225	71473375	20.3715	7.4590	2.61805	2.40964	1303.8	135265
416	173056	71991296	20.3961	7.4650	2.61909	2.40385	1306.9	135918
417	173889	72511713	20.4206	7.4710	2.62014	2.39808	1310.0	136572
418	174724	73034632	20.4450	7.4770	2.62118	2.39234	1313.2	137228
419	175561	73560059	20.4695	7.4829	2.62221	2.38664	1316.3	137885
420	176400	74088000	20.4939	7.4889	2.62325	2.38095	1319.5	138544
421	177241	74618461	20.5183	7.4948	2.62428	2.37530	1322.6	139205
422	178084	75151448	20.5426	7.5007	2.62531	2.36967	1325.8	139867
423	178929	75686967	20.5670	7.5067	2.62634	2.36407	1328.9	140531
424	179776	76225024	20.5913	7 5126	2.62737	2.35849	1332.0	141196
425	180625	76765625	20.6155	7.5185	2.62839	2.35294	1335.2	141863
426	181476	77308776	20.6398	7.5244	2.62941	2.34742	1338.3	142531
427	182329	77854483	20.6640	7.5302	2.63043	2.34192	1341.5	143201
428	183184	78402752	20.6882	7.5361	2.63144	2.33645	1344.6	143872
429	184041	78953589	20.7123	7.5420	2.63246	2.33100	1347.7	144545
430	184900	79507000	20.7364	7.5478	2.63347	2.32558	1350.9	145220
431	185761	80062991	20.7605	7.5537	2.63448	2.32019	1354.0	145896
432	186624	80621568	20.7846	7.5595	2.63548	2.31482	1357.2	146574
433	187489	81182737	20.8087	7.5654	2.63649	2.30947	1360.3	147254
434	188356	81746504	20.8327	7.5712	2.63749	2.30415	1363.5	147934
435	189225	82312875	20.8567	7.5770	2.63849	2.29885	1366.6	148617
436	190096	82881856	20.8806	7.5828	2.63949	2.29358	1369.7	149301
437	190969	83453453	20.9045	7.5886	2.64048	2.28833	1372.9	149987
438	191844	84027672	20.9284	7.5944	2.64147	2.28311	1376.0	150674
439	192721	84604519	20.9523	7.6001	2.64246	2.27790	1379.2	151363
440	193600	85184000	20 9762	7 6059	2.64345	2.27273	1382.3	152053
441	194481	85766121	21.0000	7.6117	2.64444	2.26757	1385.4	152745
442	195364	86350888	21.0238	7.6174	2.64542	2.26244	1388.6	153439
443	196249	86938307	21.0476	7.6232	2.64640	2.25734	1391.7	154134
444	197136	87528384	21.0713	7.6289	2.64738	2.25225	1394.9	154830
445	198025	88121125	21.0950	7.6346	2.64836	2.24719	1398.0	155528
446	198916	88716536	21.1187	7.6403	2.64933	2.24215	1401.2	156228
447	199809	89314623	21.1424	7.6460	2.65031	2.23714	1404.3	156930
448	200704	89915392	21.1660	7.6517	2.65128	2.23214	1407.4	157633
449	201601	90518849	21.1896	7.6574	2.65225	2.22717	1410.6	158337

SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, LOGARITHMS, RECIPROCALS, CIRCUMFERENCES AND CIRCULAR AREAS OF NOS. FROM 1 TO 1000

No.	Square	Cube	Sq. Root	Cu. Root	Log.	1000xRecip.	No. = Dia.	
							Circum.	Area
450	202500	91125000	21.2132	7.6631	2.65321	2.22222	1413.7	159043
451	203401	91733851	21.2368	7.6688	2.65418	2.21730	1416.9	159751
452	204304	92345408	21.2603	7.6744	2.65514	2.21239	1420.0	160460
453	205209	92959677	21.2838	7.6801	2.65610	2.20751	1423.1	161171
454	206116	93576664	21.3073	7.6857	2.65706	2.20264	1426.3	161883
455	207025	94196375	21.3307	7.6914	2.65801	2.19780	1429.4	162597
456	207936	94818816	21.3542	7.6970	2.65896	2.19298	1432.6	163313
457	208849	95443993	21.3776	7.7026	2.65992	2.18818	1435.7	164030
458	209764	96071912	21.4009	7.7082	2.66087	2.18341	1438.9	164748
459	210681	96702579	21.4243	7.7138	2.66181	2.17865	1442.0	165468
460	211600	97336000	21.4476	7.7194	2.66276	2.17391	1445.1	166190
461	212521	97972181	21.4709	7.7250	2.66370	2.16920	1448.3	166914
462	213444	98611128	21.4942	7.7306	2.66464	2.16450	1451.4	167639
463	214369	99252847	21.5174	7.7362	2.66558	2.15983	1454.6	168365
464	215296	99897344	21.5407	7.7418	2.66652	2.15517	1457.7	169093
465	216225	100544625	21.5639	7.7473	2.66745	2.15054	1460.8	169823
466	217156	101194696	21.5870	7.7529	2.66839	2.14592	1464.0	170554
467	218089	101847563	21.6102	7.7584	2.66932	2.14133	1467.1	171287
468	219024	102503232	21.6333	7.7639	2.67025	2.13675	1470.3	172021
469	219961	103161709	21.6564	7.7695	2.67117	2.13220	1473.4	172757
470	220900	103823000	21.6795	7.7750	2.67210	2.12766	1476.5	173494
471	221841	104487111	21.7025	7.7805	2.67302	2.12314	1479.7	174234
472	222784	105154048	21.7256	7.7860	2.67394	2.11864	1482.8	174974
473	223729	105823817	21.7486	7.7915	2.67486	2.11417	1486.0	175716
474	224676	106496424	21.7715	7.7970	2.67578	2.10971	1489.1	176460
475	225625	107171875	21.7945	7.8025	2.67669	2.10526	1492.3	177205
476	226576	107850176	21.8174	7.8079	2.67761	2.10084	1495.4	177952
477	227529	108531333	21.8403	7.8134	2.67852	2.09644	1498.5	178701
478	228484	109215352	21.8632	7.8188	2.67943	2.09205	1501.7	179451
479	229441	109902239	21.8861	7.8243	2.68034	2.08768	1504.8	180203
480	230400	110592000	21.9089	7.8297	2.68124	2.08333	1508.0	180956
481	231361	111284641	21.9317	7.8352	2.68215	2.07900	1511.1	181711
482	232324	111980168	21.9545	7.8406	2.68305	2.07469	1514.3	182467
483	233289	112678587	21.9773	7.8460	2.68395	2.07039	1517.4	183225
484	234256	113379904	22.0000	7.8514	2.68485	2.06612	1520.5	183984
485	235225	114084125	22.0227	7.8568	2.68574	2.06186	1523.7	184745
486	236196	114791256	22.0454	7.8622	2.68664	2.05761	1526.8	185508
487	237169	115501303	22.0681	7.8676	2.68753	2.05339	1530.0	186272
488	238144	116214272	22.0907	7.8730	2.68842	2.04918	1533.1	187038
489	239121	116930169	22.1133	7.8784	2.68931	2.04499	1536.2	187805
490	240100	117649000	22.1359	7.8837	2.69020	2.04082	1539.4	188574
491	241081	118370771	22.1585	7.8891	2.69108	2.03666	1542.5	189345
492	242064	119095488	22.1811	7.8944	2.69197	2.03252	1545.7	190117
493	243049	119823157	22.2036	7.8998	2.69285	2.02840	1548.8	190890
494	244036	120553784	22.2261	7.9051	2.69373	2.02429	1551.9	191665
495	245025	121287375	22.2486	7.9105	2.69461	2.02020	1555.1	192442
496	246016	122023936	22.2711	7.9158	2.69548	2.01613	1558.2	193221
497	247009	122763473	22.2935	7.9211	2.69636	2.01207	1561.4	194000
498	248004	123505992	22.3159	7.9264	2.69723	2.00803	1564.5	194782
499	249001	124251499	22.3383	7.9317	2.69810	2.00401	1567.7	195565

SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, LOGARITHMS, RECIPROCALS, CIRCUMFERENCES AND CIRCULAR AREAS OF NOS. FROM 1 TO 1000

No.	Square	Cube	Sq. Root	Cu. Root	Log.	1000xRecip.	No. = Dia.	
							Circum.	Area
500	250000	125000000	22.3607	7.9370	2.69897	2.00000	1570.8	196350
501	251001	125751501	22.3830	7.9423	2.69984	1.99601	1573.9	197136
502	252004	126506008	22.4054	7.9476	2.70070	1.99203	1577.1	197923
503	253009	127263527	22.4277	7.9528	2.70157	1.98807	1580.2	198713
504	254016	128024064	22.4499	7.9581	2.70243	1.98413	1583.4	199504
505	255025	128787625	22.4722	7.9634	2.70329	1.98020	1586.5	200296
506	256036	129554216	22.4944	7.9686	2.70415	1.97629	1589.7	201090
507	257049	130323843	22.5167	7.9739	2.70501	1.97239	1592.8	201886
508	258064	131096512	22.5389	7.9791	2.70586	1.96850	1595.9	202683
509	259081	131872229	22.5610	7.9843	2.70672	1.96464	1599.1	202482
510	260100	132651000	22.5832	7.9896	2.70757	1.96078	1602.2	204282
511	261121	133432831	22.6053	7.9948	2.70842	1.95695	1605.4	205084
512	262144	134217728	22.6274	8.0000	2.70927	1.95312	1608.5	205887
513	263169	135005697	22.6495	8.0052	2.71012	1.94932	1611.6	206692
514	264196	135796744	22.6716	8.0104	2.71096	1.94553	1614.8	207499
515	265225	136590875	22.6936	8.0156	2.71181	1.94175	1617.9	208307
516	266256	137388096	22.7156	8.0208	2.71265	1.93798	1621.1	209117
517	267289	138188413	22.7376	8.0260	2.71349	1.93424	1624.2	209928
518	268324	138991832	22.7596	8.0311	2.71433	1.93050	1627.3	210741
519	269361	139798359	22.7816	8.0363	2.71517	1.92678	1630.5	211556
520	270400	140608000	22.8035	8.0415	2.71600	1.92308	1633.6	212372
521	271441	141420761	22.8254	8.0466	2.71684	1.91939	1636.8	213189
522	272484	142236648	22.8473	8.0517	2.71767	1.91571	1639.9	214008
523	273529	143055667	22.8692	8.0569	2.71850	1.91205	1643.1	214829
524	274576	143877824	22.8910	8.0620	2.71933	1.90840	1646.2	215651
525	275625	144703125	22.9129	8.0671	2.72016	1.90476	1649.3	216475
526	276676	145531576	22.9347	8.0723	2.72099	1.90114	1652.5	217301
527	277729	146363183	22.9565	8.0774	2.72181	1.89753	1655.6	218128
528	278784	147197952	22.9783	8.0825	2.72263	1.89394	1658.8	218956
529	279841	148035889	23.0000	8.0876	2.72346	1.89036	1661.9	219787
530	280900	148877000	23.0217	8.0927	2.72428	1.88679	1665.0	220618
531	281961	149721291	23.0434	8.0978	2.72509	1.88324	1668.2	221452
532	283024	150568768	23.0651	8.1028	2.72591	1.87970	1671.3	222287
533	284089	151419437	23.0868	8.1079	2.72673	1.87617	1674.5	223123
534	285156	152273304	23.1084	8.1130	2.72754	1.87266	1677.6	223961
535	286225	153130375	23.1301	8.1180	2.72835	1.86916	1680.8	224801
536	287296	153990656	23.1517	8.1231	2.72916	1.86567	1683.9	225642
537	288369	154854153	23.1733	8.1281	2.72997	1.86220	1687.0	226484
538	289444	155720872	23.1948	8.1332	2.73078	1.85874	1690.2	227329
539	290521	156590819	23.2164	8.1382	2.73159	1.85529	1693.3	228175
540	291600	157464000	23.2379	8.1433	2.73239	1.85185	1696.5	229022
541	292681	158340421	23.2594	8.1483	2.73320	1.84843	1699.6	229871
542	293764	159220088	23.2809	8.1533	2.73400	1.84502	1702.7	230722
543	294849	160103007	23.3024	8.1583	2.73480	1.84162	1705.9	231574
544	295936	160989184	23.3238	8.1633	2.73560	1.83824	1709.0	232428
545	297025	161878625	23.3452	8.1683	2.73640	1.83486	1712.2	233283
546	298116	162771336	23.3666	8.1733	2.73719	1.83150	1715.3	234140
547	299209	163667323	23.3880	8.1783	2.73799	1.82815	1718.5	234998
548	300304	164566592	23.4094	8.1833	2.73878	1.82482	1721.6	235858
549	301401	165469149	23.4307	8.1882	2.73957	1.82149	1724.7	236720

SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, LOGARITHMS, RECIPROCALS, CIRCUMFERENCES AND CIRCULAR AREAS OF NOS. FROM 1 TO 1000

No.	Square	Cube	Sq. Root	Cu. Root	Log.	1000xRecip.	No. = Dia.	
							Circum.	Area
550	302500	166375000	23.4521	8.1932	2.74036	1.81818	1727.9	237583
551	303601	167284151	23.4734	8.1982	2.74115	1.81488	1731.0	238448
552	304704	168196608	23.4947	8.2031	2.74194	1.81159	1734.2	239314
553	305809	169112377	23.5160	8.2081	2.74273	1.80832	1737.3	240182
554	306916	170031464	23.5372	8.2130	2.74351	1.80505	1740.4	241051
555	308025	170953875	23.5584	8.2180	2.74429	1.80180	1743.6	241922
556	309136	171879616	23.5797	8.2229	2.74507	1.79856	1746.7	242795
557	310249	172808693	23.6008	8.2278	2.74586	1.79533	1749.9	243669
558	311364	173741112	23.6220	8.2327	2.74663	1.79211	1753.0	244545
559	312481	174676879	23.6432	8.2377	2.74741	1.78891	1756.2	245422
560	313600	175616000	23.6643	8.2426	2.74819	1.78571	1759.3	246301
561	314721	176558481	23.6854	8.2475	2.74896	1.78253	1762.4	247181
562	315844	177504328	23.7065	8.2524	2.74974	1.77936	1765.6	248063
563	316969	178453547	23.7276	8.2573	2.75051	1.77620	1768.7	248947
564	318096	179406144	23.7487	8.2621	2.75128	1.77305	1771.9	249832
565	319225	180362125	23.7697	8.2670	2.75205	1.76991	1775.0	250719
566	320356	181321496	23.7908	8.2719	2.75282	1.76678	1778.1	251607
567	321489	182284263	23.8118	8.2768	2.75358	1.76367	1781.3	252497
568	322624	183250432	23.8328	8.2816	2.75435	1.76056	1784.4	253388
569	323761	184220009	23.8537	8.2865	2.75511	1.75747	1787.6	254281
570	324900	185193000	23.8747	8.2913	2.75587	1.75439	1790.7	255176
571	326041	186169411	23.8956	8.2962	2.75664	1.75131	1793.9	256072
572	327184	187149248	23.9165	8.3010	2.75740	1.74825	1797.0	256970
573	328329	188132517	23.9374	8.3059	2.75815	1.74520	1800.1	257869
574	329476	189119224	23.9583	8.3107	2.75891	1.74216	1803.3	258770
575	330625	190109375	23.9792	8.3155	2.75967	1.73913	1806.4	259672
576	331776	191102976	24.0000	8.3203	2.76042	1.73611	1809.6	260576
577	332929	192100033	24.0208	8.3251	2.76118	1.73310	1812.7	261482
578	334084	193100552	24.0416	8.3300	2.76193	1.73010	1815.8	262389
579	335241	194104539	24.0624	8.3348	2.76268	1.72712	1819.0	263298
580	336400	195112000	24.0832	8.3396	2.76343	1.72414	1822.1	264208
581	337561	196122941	24.1039	8.3443	2.76418	1.72117	1825.3	265120
582	338724	197137368	24.1247	8.3491	2.76492	1.71821	1828.4	266033
583	339889	198155287	24.1454	8.3539	2.76567	1.71527	1831.6	266948
584	341056	199176704	24.1661	8.3587	2.76641	1.71233	1834.7	267865
585	342225	200201625	24.1868	8.3634	2.76716	1.70940	1837.8	268783
586	343396	201230056	24.2074	8.3682	2.76790	1.70649	1841.0	269701
587	344569	202262003	24.2281	8.3730	2.76864	1.70358	1844.1	270624
588	345744	203297472	24.2487	8.3777	2.76938	1.70068	1847.3	271547
589	346921	204336469	24.2693	8.3825	2.77012	1.69779	1850.4	272471
590	348100	205379000	24.2899	8.3872	2.77085	1.69492	1853.5	273397
591	349281	206425071	24.3105	8.3919	2.77159	1.69205	1856.7	274325
592	350464	207474688	24.3311	8.3967	2.77232	1.68919	1859.8	275254
593	351649	208527857	24.3516	8.4014	2.77305	1.68634	1863.0	276184
594	352836	209584584	24.3721	8.4061	2.77379	1.68350	1866.1	277117
595	354025	210644875	24.3926	8.4108	2.77452	1.68067	1869.3	278051
596	355216	211708736	24.4131	8.4155	2.77525	1.67785	1872.4	278986
597	356409	212776173	24.4336	8.4202	2.77597	1.67504	1875.5	279923
598	357604	213847192	24.4540	8.4249	2.77670	1.67224	1878.7	280862
599	358801	214921799	24.4745	8.4296	2.77743	1.66945	1881.8	281802

SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, LOGARITHMS, RECIPROCALS, CIRCUMFERENCES AND CIRCULAR AREAS OF NOS. FROM 1 TO 1000

No.	Square	Cube	Sq. Root	Cu. Root	Log.	1000xRecip.	No. = Dia.	
							Circum.	Area
600	360000	216000000	24.4949	8.4343	2.77815	1.66667	1885.0	282743
601	361201	217081801	24.5153	8.4390	2.77887	1.66389	1888.1	283687
602	362404	218167208	24.5357	8.4437	2.77960	1.66113	1891.2	284631
603	363609	219256227	24.5561	8.4484	2.78032	1.65837	1894.4	285578
604	364816	220348864	24.5764	8.4530	2.78104	1.65563	1897.5	286526
605	366025	221445125	24.5967	8.4577	2.78176	1.65289	1900.7	287475
606	367236	222545016	24.6171	8.4623	2.78247	1.65017	1903.8	288426
607	368449	223648543	24.6374	8.4670	2.78319	1.64745	1907.0	289379
608	369664	224755712	24.6577	8.4716	2.78390	1.64474	1910.1	290333
609	370881	225866529	24.6779	8.4763	2.78462	1.64204	1913.2	291289
610	372100	226981000	24.6982	8.4809	2.78533	1.63934	1916.4	292247
611	373321	228099131	24.7184	8.4856	2.78604	1.63666	1919.5	293206
612	374544	229220928	24.7386	8.4902	2.78675	1.63399	1922.7	294166
613	375769	230346397	24.7588	8.4948	2.78746	1.63132	1925.8	295128
614	376996	231475544	24.7790	8.4994	2.78817	1.62866	1928.9	296092
615	378225	232608375	24.7992	8.5040	2.78888	1.62602	1932.1	297057
616	379456	233744896	24.8193	8.5086	2.78958	1.62338	1935.2	298024
617	380689	234885113	24.8395	8.5132	2.79029	1.62075	1938.4	298992
618	381924	236029032	24.8596	8.5178	2.79099	1.61812	1941.5	299962
619	383161	237176659	24.8797	8.5224	2.79169	1.61551	1944.7	300934
620	384400	238328000	24.8998	8.5270	2.79239	1.61290	1947.8	301907
621	385641	239483061	24.9199	8.5316	2.79309	1.61031	1950.9	302882
622	386884	240641848	24.9399	8.5362	2.79379	1.60772	1954.1	303858
623	388129	241804367	24.9600	8.5408	2.79449	1.60514	1957.2	304836
624	389376	242970624	24.9800	8.5453	2.79518	1.60256	1960.4	305815
625	390625	244140625	25.0000	8.5499	2.79588	1.60000	1963.5	306796
626	391876	245314376	25.0200	8.5544	2.79657	1.59744	1966.6	307779
627	393129	246491883	25.0400	8.5590	2.79727	1.59490	1969.8	308763
628	394384	247673152	25.0599	8.5635	2.79796	1.59236	1972.9	309748
629	395641	248858189	25.0799	8.5681	2.79865	1.58983	1976.1	310736
630	396900	250047000	25.0998	8.5726	2.79934	1.58730	1979.2	311725
631	398161	251239591	25.1197	8.5772	2.80003	1.58479	1982.4	312715
632	399424	252435968	25.1396	8.5817	2.80072	1.58228	1985.5	313707
633	400689	253636137	25.1595	8.5862	2.80140	1.57978	1988.6	314700
634	401956	254840104	25.1794	8.5907	2.80209	1.57729	1991.8	315696
635	403225	256047875	25.1992	8.5952	2.80277	1.57480	1994.9	316692
636	404496	257259456	25.2190	8.5997	2.80346	1.57233	1998.1	317690
637	405769	258474853	25.2389	8.6043	2.80414	1.56986	2001.2	318690
638	407044	259694072	25.2587	8.6088	2.80482	1.56740	2004.3	319692
639	408321	260917119	25.2784	8.6132	2.80550	1.56495	2007.5	320695
640	409600	262144000	25.2982	8.6177	2.80618	1.56250	2010.6	321699
641	410881	263374721	25.3180	8.6222	2.80686	1.56006	2013.8	322705
642	412164	264609288	25.3377	8.6267	2.80754	1.55763	2016.9	323713
643	413449	265847707	25.3574	8.6312	2.80821	1.55521	2020.0	324722
644	414736	267089984	25.3772	8.6357	2.80889	1.55280	2023.2	325733
645	416025	268336125	25.3969	8.6401	2.80956	1.55039	2026.3	326745
646	417316	269586136	25.4165	8.6446	2.81023	1.54799	2029.5	327759
647	418609	270840023	25.4362	8.6490	2.81090	1.54560	2032.6	328775
648	419904	272097792	25.4558	8.6535	2.81158	1.54321	2035.8	329792
649	421201	273359449	25.4755	8.6579	2.81224	1.54083	2038.9	330810

SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, LOGARITHMS, RECIPROCALS, CIRCUMFERENCES AND CIRCULAR AREAS OF NOS. FROM 1 TO 1000

No.	Square	Cube	Sq. Root	Cu. Root	Log.	1000xRecip.	No. = Dia.	
							Circum.	Area
650	422500	274625000	25.4951	8.6624	2.81291	1.53846	2042.0	331831
651	423801	275894451	25.5147	8.6668	2.81358	1.53610	2045.2	332853
652	425104	277167808	25.5343	8.6713	2.81425	1.53374	2048.3	333876
653	426409	278445077	25.5539	8.6757	2.81491	1.53139	2051.5	334901
654	427716	279726264	25.5734	8.6801	2.81558	1.52905	2054.6	335927
655	429025	281011375	25.5930	8.6845	2.81624	1.52672	2057.7	336955
656	430336	282300416	25.6125	8.6890	2.81690	1.52439	2060.9	337985
657	431649	283593393	25.6320	8.6934	2.81757	1.52207	2064.0	339016
658	432964	284890312	25.6515	8.6978	2.81823	1.51976	2067.2	340049
659	434281	286191179	25.6710	8.7022	2.81889	1.51745	2070.3	341084
660	435600	287496000	25.6905	8.7066	2.81954	1.51515	2073.5	342119
661	436921	288804781	25.7099	8.7110	2.82020	1.51286	2076.6	343157
662	438244	290117528	25.7294	8.7154	2.82086	1.51057	2079.7	344196
663	439569	291434247	25.7488	8.7198	2.82151	1.50830	2082.9	345237
664	440896	292754944	25.7682	8.7241	2.82217	1.50602	2086.0	346279
665	442225	294079625	25.7876	8.7285	2.82282	1.50376	2089.2	347323
666	443556	295408296	25.8070	8.7329	2.82347	1.50150	2092.3	348368
667	444889	296740963	25.8263	8.7373	2.82413	1.49925	2095.4	349415
668	446224	298077632	25.8457	8.7416	2.82478	1.49701	2098.6	350464
669	447561	299418309	25.8650	8.7460	2.82543	1.49477	2101.7	351514
670	448900	300763000	25.8844	8.7503	2.82607	1.49254	2104.9	352565
671	450241	302111711	25.9037	8.7547	2.82672	1.49031	2108.0	353618
672	451584	303464448	25.9230	8.7590	2.82737	1.48810	2111.2	354673
673	452929	304821217	25.9422	8.7634	2.82802	1.48588	2114.3	355730
674	454276	306182024	25.9615	8.7677	2.82866	1.48368	2117.4	356788
675	455625	307546875	25.9808	8.7721	2.82930	1.48148	2120.6	357847
676	456976	308915776	26.0000	8.7764	2.82995	1.47929	2123.7	358908
677	458329	310288733	26.0192	8.7807	2.83059	1.47711	2126.9	359971
678	459684	311665752	26.0384	8.7850	2.83123	1.47493	2130.0	361035
679	461041	313046839	26.0576	8.7893	2.83187	1.47275	2133.1	362101
680	462400	314432000	26.0768	8.7937	2.83251	1.47059	2136.3	363168
681	463761	315821241	26.0960	8.7980	2.83315	1.46843	2139.4	364237
682	465124	317214568	26.1151	8.8023	2.83378	1.46628	2142.6	365308
683	466489	318611987	26.1343	8.8066	2.83442	1.46413	2145.7	366380
684	467856	320013504	26.1534	8.8109	2.83506	1.46199	2148.9	367453
685	469225	321419125	26.1725	8.8152	2.83569	1.45985	2152.0	368528
686	470596	322828856	26.1916	8.8194	2.83632	1.45773	2155.1	369605
687	471969	324242703	26.2107	8.8237	2.83696	1.45560	2158.3	370684
688	473344	325660672	26.2298	8.8280	2.83759	1.45349	2161.4	371764
689	474721	327082769	26.2488	8.8323	2.83822	1.45138	2164.6	372845
690	476100	328509000	26.2679	8.8366	2.83885	1.44928	2167.7	373928
691	477481	329939371	26.2869	8.8408	2.83948	1.44718	2170.8	375013
692	478864	331373888	26.3059	8.8451	2.84011	1.44509	2174.0	376099
693	480249	332812557	26.3249	8.8493	2.84073	1.44300	2177.1	377187
694	481636	334255384	26.3439	8.8536	2.84136	1.44092	2180.3	378276
695	483025	335702375	26.3629	8.8578	2.84198	1.43885	2183.4	379367
696	484416	337153536	26.3818	8.8621	2.84261	1.43678	2186.6	380459
697	485809	338608873	26.4008	8.8663	2.84323	1.43472	2189.7	381554
698	487204	340068392	26.4197	8.8706	2.84386	1.43267	2192.8	382649
699	488601	341532099	26.4386	8.8748	2.84448	1.43062	2196.0	383746

SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, LOGARITHMS, RECIPROCALS, CIRCUMFERENCES AND CIRCULAR AREAS OF NOS. FROM 1 TO 1000

No.	Square	Cube	Sq. Root	Cu. Root	Log.	1000xRecip.	No. = Dia.	
							Circum.	Area
700	490000	343000000	26.4575	8.8790	2.84510	1.42857	2199.1	384845
701	491401	344472101	26.4764	8.8833	2.84572	1.42653	2202.3	385945
702	492804	345948408	26.4953	8.8875	2.84634	1.42450	2205.4	387047
703	494209	347428927	26.5141	8.8917	2.84696	1.42248	2208.5	388151
704	495616	348913664	26.5330	8.8959	2.84757	1.42046	2211.7	389256
705	497025	350402625	26.5518	8.9001	2.84819	1.41844	2214.8	390363
706	498436	351895816	26.5707	8.9043	2.84880	1.41643	2218.0	391471
707	499849	353393243	26.5895	8.9085	2.84942	1.41443	2221.1	392580
708	501264	354894912	26.6083	8.9127	2.85003	1.41243	2224.3	393692
709	502681	356400829	26.6271	8.9169	2.85065	1.41044	2227.4	394805
710	504100	357911000	26.6458	8.9211	2.85126	1.40845	2230.5	395919
711	505521	359425431	26.6646	8.9253	2.85187	1.40647	2233.7	297035
712	506944	360944128	26.6833	8.9295	2.85248	1.40449	2236.8	398153
713	508369	362467097	26.7021	8.9337	2.85309	1.40253	2240.0	399272
714	509796	363994344	26.7208	8.9378	2.85370	1.40056	2243.1	400393
715	511225	365525875	26.7395	8.9420	2.85431	1.39860	2246.2	401515
716	512656	367061696	26.7582	8.9462	2.85491	1.39665	2249.4	402639
717	514089	368601813	26.7769	8.9503	2.85552	1.39470	2252.5	403765
718	515524	370146232	26.7955	8.9545	2.85612	1.39276	2255.7	404892
719	516961	371694959	26.8142	8.9587	2.85673	1.39082	2258.8	406020
720	518400	373248000	26.8328	8.9628	2.85733	1.38889	2261.9	407150
721	519841	374805361	26.8514	8.9670	2.85794	1.38696	2265.1	408282
722	521284	376367048	26.8701	8.9711	2.85854	1.38504	2268.2	409416
723	522729	377933067	26.8887	8.9752	2.85914	1.38313	2271.4	410550
724	524176	379503424	26.9072	8.9794	2.85974	1.38122	2274.5	411687
725	525625	381078125	26.9258	8.9835	2.86034	1.37931	2277.7	412825
726	527076	382657176	26.9444	8.9876	2.86094	1.37741	2280.8	413965
727	528529	384240583	26.9629	8.9918	2.86153	1.37552	2283.9	415106
728	529984	385828352	26.9815	8.9959	2.86213	1.37363	2287.1	416248
729	531441	387420489	27.0000	9.0000	2.86273	1.37174	2290.2	417393
730	532900	389017000	27.0185	9.0041	2.86332	1.36986	2293.4	418539
731	534361	390617891	27.0370	9.0082	2.86392	1.36799	2296.5	419686
732	535824	392223168	27.0555	9.0123	2.86451	1.36612	2299.7	420835
733	537289	393832837	27.0740	9.0164	2.86510	1.36426	2302.8	421986
734	538756	395446904	27.0924	9.0205	2.86570	1.36240	2305.9	423138
735	540225	397065375	27.1109	9.0246	2.86629	1.36054	2309.1	424293
736	541696	398688256	27.1293	9.0287	2.86688	1.35870	2312.2	425448
737	543169	400315553	27.1477	9.0328	2.86747	1.35685	2315.4	426604
738	544644	401947272	27.1662	9.0369	2.86806	1.35501	2318.5	427762
739	546121	403583419	27.1846	9.0410	2.86864	1.35318	2321.6	428922
740	547600	405224000	27.2029	9.0450	2.86923	1.35135	2324.8	430084
741	549081	406869021	27.2213	9.0491	2.86982	1.34953	2327.9	431247
742	550564	408518488	27.2397	9.0532	2.87040	1.34771	2331.1	432412
743	552049	410172407	27.2580	9.0572	2.87099	1.34590	2334.2	433578
744	553536	411830784	27.2764	9.0613	2.87157	1.34409	2337.3	434746
745	555025	413493625	27.2947	9.0654	2.87216	1.34228	2340.5	435916
746	556516	415160936	27.3130	9.0694	2.87274	1.34048	2343.6	437087
747	558009	416832723	27.3313	9.0735	2.87332	1.33869	2346.8	438259
748	559504	418508992	27.3496	9.0775	2.87390	1.33690	2349.9	439433
749	561001	420189749	27.3679	9.0816	2.87448	1.33511	2353.1	440609

SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, LOGARITHMS, RECIPROCALS, CIRCUMFERENCES AND CIRCULAR AREAS OF NOS. FROM 1 TO 1000

No.	Square	Cube	Sq. Root	Cu. Root	Log.	1000×Recip.	No. = Dia. Circum.	No. = Dia. Area
750	562500	421875000	27.3861	9.0856	2.87506	1.33333	2356.2	441786
751	564001	423564751	27.4044	9.0896	2.87564	1.33156	2359.3	442965
752	565504	425259008	27.4226	9.0937	2.87622	1.32979	2362.5	444146
753	567009	426957777	27.4408	9.0977	2.87680	1.32802	2365.6	445328
754	568516	428661064	27.4591	9.1017	2.87737	1.32626	2368.8	446511
755	570025	430368875	27.4773	9.1057	2.87795	1.32450	2371.9	447697
756	571536	432081216	27.4955	9.1098	2.87852	1.32275	2375.0	448883
757	573049	433798093	27.5136	9.1138	2.87910	1.32100	2378.2	450072
758	574564	435519512	27.5318	9.1178	2.87967	1.31926	2381.3	451262
759	576081	437245479	27.5500	9.1218	2.88024	1.31752	2384.5	452453
760	577600	438976000	27.5681	9.1258	2.88081	1.31579	2387.6	453646
761	579121	440711081	27.5862	9.1298	2.88138	1.31406	2390.8	454841
762	580644	442450728	27.6043	9.1338	2.88196	1.31234	2393.9	456037
763	582169	444194947	27.6225	9.1378	2.88252	1.31062	2397.0	457234
764	583696	445943744	27.6405	9.1418	2.88309	1.30890	2400.2	458434
765	585225	447697125	27.6586	9.1458	2.88366	1.30719	2403.3	459635
766	586756	449455096	27.6767	9.1498	2.88423	1.30548	2406.5	460837
767	588289	451217663	27.6948	9.1537	2.88480	1.30378	2409.6	462042
768	589824	452984832	27.7128	9.1577	2.88536	1.30208	2412.7	463247
769	591361	454756609	27.7308	9.1617	2.88593	1.30039	2415.9	464454
770	592900	456533000	27.7489	9.1657	2.88649	1.29870	2419.0	465663
771	594441	458314011	27.7669	9.1696	2.88705	1.29702	2422.2	466873
772	595984	460099648	27.7849	9.1736	2.88762	1.29534	2425.3	468085
773	597529	461889917	27.8029	9.1775	2.88818	1.29366	2428.5	469298
774	599076	463684824	27.8209	9.1815	2.88874	1.29199	2431.6	470513
775	600625	465484375	27.8388	9.1855	2.88930	1.29032	2434.7	471730
776	602176	467288576	27.8568	9.1894	2.88986	1.28866	2437.9	472948
777	603729	469097433	27.8747	9.1933	2.89042	1.28700	2441.0	474168
778	605284	470910952	27.8927	9.1973	2.89098	1.28535	2444.2	475389
779	606841	472729139	27.9106	9.2012	2.89154	1.28370	2447.3	476612
780	608400	474552000	27.9285	9.2052	2.89209	1.28205	2450.4	477836
781	609961	476379541	27.9464	9.2091	2.89265	1.28041	2453.6	479062
782	611524	478211768	27.9643	9.2130	2.89321	1.27877	2456.7	480290
783	613089	480048687	27.9821	9.2170	2.89376	1.27714	2459.9	481519
784	614656	481890304	28.0000	9.2209	2.89432	1.27551	2463.0	482750
785	616225	483736625	28.0179	9.2248	2.89487	1.27389	2466.2	483982
786	617796	485587656	28.0357	9.2287	2.89542	1.27226	2469.3	485216
787	619369	487443403	28.0535	9.2326	2.89597	1.27065	2472.4	486451
788	620944	489303872	28.0713	9.2365	2.89653	1.26904	2475.6	487688
789	622521	491169069	28.0891	9.2404	2.89708	1.26743	2478.7	488927
790	624100	493039000	28.1069	9.2443	2.89763	1.26582	2481.9	490167
791	625681	494913671	28.1247	9.2482	2.89818	1.26422	2485.0	491409
792	627264	496793088	28.1425	9.2521	2.89873	1.26263	2488.1	492652
793	628849	498677257	28.1603	9.2560	2.89927	1.26103	2491.3	493897
794	630436	500566184	28.1780	9.2599	2.89982	1.25945	2494.4	495143
795	632025	502459875	28.1957	9.2638	2.90037	1.25786	2497.6	496391
796	633616	504358336	28.2135	9.2677	2.90091	1.25628	2500.7	497641
797	635209	506261573	28.2312	9.2716	2.90146	1.25471	2503.8	498892
798	636804	508169592	28.2489	9.2754	2.90200	1.25313	2507.0	500145
799	638401	510082399	28.2666	9.2793	2.90255	1.25156	2510.1	501399

SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, LOGARITHMS, RECIPROCALS, CIRCUMFERENCES AND CIRCULAR AREAS OF NOS. FROM 1 TO 1000

No.	Square	Cube	Sq. Root	Cu. Root	Log.	1000xRecip.	No. = Dia.	
							Circum.	Area
800	640000	512000000	28.2843	9.2832	2.90309	1.25000	2513.3	502655
801	641601	513922401	28.3019	9.2870	2.90363	1.24844	2516.4	503912
802	643204	515849608	28.3196	9.2909	2.90417	1.24688	2519.6	505171
803	644809	517781627	28.3373	9.2948	2.90472	1.24533	2522.7	506432
804	646416	519718464	28.3549	9.2986	2.90526	1.24378	2525.8	507694
805	648025	521660125	28.3725	9.3025	2.90580	1.24224	2529.0	508958
806	649636	523606616	28.3901	9.3063	2.90634	1.24069	2532.1	510223
807	651249	525557943	28.4077	9.3102	2.90687	1.23916	2535.3	511490
808	652864	527514112	28.4253	9.3140	2.90741	1.23762	2538.4	512758
809	654481	529475129	28.4429	9.3179	2.90795	1.23609	2541.5	514028
810	656100	531441000	28.4605	9.3217	2.90849	1.23457	2544.7	515300
811	657721	533411731	28.4781	9.3255	2.90902	1.23305	2547.8	516573
812	659344	535387328	28.4956	9.3294	2.90956	1.23153	2551.0	517848
813	660969	537367797	28.5132	9.3332	2.91009	1.23001	2554.1	519124
814	662596	539353144	28.5307	9.3370	2.91062	1.22850	2557.3	520402
815	664225	541343375	28.5482	9.3408	2.91116	1.22699	2560.4	521681
816	665856	543338496	28.5657	9.3447	2.91169	1.22549	2563.5	522962
817	667489	545338513	28.5832	9.3485	2.91222	1.22399	2566.7	524245
818	669124	547343432	28.6007	9.3523	2.91275	1.22249	2569.8	525529
819	670761	549353259	28.6182	9.3561	2.91328	1.22100	2573.0	526814
820	672400	551368000	28.6356	9.3599	2.91381	1.21951	2576.1	528102
821	674041	553387661	28.6531	9.3637	2.91434	1.21803	2579.2	529391
822	675684	555412248	28.6705	9.3675	2.91487	1.21655	2582.4	530681
823	677329	557441767	28.6880	9.3713	2.91540	1.21507	2585.5	531973
824	678976	559476224	28.7054	9.3751	2.91593	1.21359	2588.7	533267
825	680625	561515625	28.7228	9.3789	2.91645	1.21212	2591.8	534562
826	682276	563559976	28.7402	9.3827	2.91698	1.21065	2595.0	535858
827	683929	565609283	28.7576	9.3865	2.91751	1.20919	2598.1	537157
828	685584	567663552	28.7750	9.3902	2.91803	1.20773	2601.2	538456
829	687241	569722789	28.7924	9.3940	2.91855	1.20627	2604.4	539758
830	688900	571787000	28.8097	9.3978	2.91908	1.20482	2607.5	541061
831	690561	573856191	28.8271	9.4016	2.91960	1.20337	2610.7	542365
832	692224	575930368	28.8444	9.4053	2.92012	1.20192	2613.8	543671
833	693889	578009537	28.8617	9.4091	2.92065	1.20048	2616.9	544979
834	695556	580093704	28.8791	9.4129	2.92117	1.19904	2620.1	546288
835	697225	582182875	28.8964	9.4166	2.92169	1.19760	2623.2	547599
836	698896	584277056	28.9137	9.4204	2.92221	1.19617	2626.4	548912
837	700569	586376253	28.9310	9.4241	2.92273	1.19474	2629.5	550226
838	702244	588480472	28.9482	9.4279	2.92324	1.19332	2632.7	551541
839	703921	590589719	28.9655	9.4316	2.92376	1.19189	2635.8	552858
840	705600	592704000	28.9828	9.4354	2.92428	1.19048	2638.9	554177
841	707281	594823321	29.0000	9.4391	2.92480	1.18906	2642.1	555497
842	708964	596947688	29.0172	9.4429	2.92531	1.18765	2645.2	556819
843	710649	599077107	29.0345	9.4466	2.92583	1.18624	2648.4	558142
844	712336	601211584	29.0517	9.4503	2.92634	1.18483	2651.5	559467
845	714025	603351125	29.0689	9.4541	2.92686	1.18343	2654.6	560794
846	715716	605495736	29.0861	9.4578	2.92737	1.18203	2657.8	562122
847	717409	607645423	29.1033	9.4615	2.92788	1.18064	2660.9	563452
848	719104	609800192	29.1204	9.4652	2.92840	1.17925	2664.1	564783
849	720801	611960049	29.1376	9.4690	2.92891	1.17786	2667.2	566116

SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, LOGARITHMS, RECIPROCALS, CIRCUMFERENCES AND CIRCULAR AREAS OF NOS. FROM 1 TO 1000

No.	Square	Cube	Sq. Root	Cu. Root	Log.	1000xRecip.	No. = Dia.	
							Circum.	Area
850	722500	614125000	29.1548	9.4727	2.92942	1.17647	2670.4	567450
851	724201	616295051	29.1719	9.4764	2.92993	1.17509	2673.5	568786
852	725904	618470208	29.1890	9.4801	2.93044	1.17371	2676.6	570124
853	727609	620650477	29.2062	9.4838	2.93095	1.17233	2679.8	571463
854	729316	622835864	29.2233	9.4875	2.93146	1.17096	2682.9	572803
855	731025	625026375	29.2404	9.4912	2.93197	1.16959	2686.1	574146
856	732736	627222016	29.2575	9.4949	2.93247	1.16822	2689.2	575490
857	734449	629422793	29.2746	9.4986	2.93298	1.16686	2692.3	576835
858	736164	631628712	29.2916	9.5023	2.93349	1.16550	2695.5	578182
859	737881	633839779	29.3087	9.5060	2.93399	1.16414	2698.6	579530
860	739600	636056000	29.3258	9.5097	2.93450	1.16279	2701.8	580880
861	741321	638277381	29.3428	9.5134	2.93500	1.16144	2704.9	582232
862	743044	640503928	29.3598	9.5171	2.93551	1.16009	2708.1	583585
863	744769	642735647	29.3769	9.5207	2.93601	1.15875	2711.2	584940
864	746496	644972544	29.3939	9.5244	2.93651	1.15741	2714.3	586297
865	748225	647214625	29.4109	9.5281	2.93702	1.15607	2717.5	587655
866	749956	649461896	29.4279	9.5317	2.93752	1.15473	2720.6	589014
867	751689	651714363	29.4449	9.5354	2.93802	1.15340	2723.8	590375
868	753424	653972032	29.4618	9.5391	2.93852	1.15207	2726.9	591738
869	755161	656234909	29.4788	9.5427	2.93902	1.15075	2730.0	593102
870	756900	658503000	29.4958	9.5464	2.93952	1.14943	2733.2	594468
871	758641	660776311	29.5127	9.5501	2.94002	1.14811	2736.3	595835
872	760384	663054848	29.5296	9.5537	2.94052	1.14679	2739.5	597204
873	762129	665338617	29.5466	9.5574	2.94101	1.14548	2742.6	598575
874	763876	667627624	29.5635	9.5610	2.94151	1.14416	2745.8	599947
875	765625	669921875	29.5804	9.5647	2.94201	1.14286	2748.9	601320
876	767376	672221376	29.5973	9.5683	2.94250	1.14155	2752.0	602696
877	769129	674526133	29.6142	9.5719	2.94300	1.14025	2755.2	604073
878	770884	676836152	29.6311	9.5756	2.94349	1.13895	2758.3	605451
879	772641	679151439	29.6479	9.5792	2.94399	1.13766	2761.5	606831
880	774400	681472000	29.6648	9.5828	2.94448	1.13636	2764.6	608212
881	776161	683797841	29.6816	9.5865	2.94498	1.13507	2767.7	609595
882	777924	686128968	29.6985	9.5901	2.94547	1.13379	2770.9	610980
883	779689	688465387	29.7153	9.5937	2.94596	1.13250	2774.0	612366
884	781456	690807104	29.7321	9.5973	2.94645	1.13122	2777.2	613754
885	783225	693154125	29.7489	9.6010	2.94694	1.12994	2780.3	615143
886	784996	695506456	29.7658	9.6046	2.94743	1.12867	2783.5	616534
887	786769	697864103	29.7825	9.6082	2.94792	1.12740	2786.6	617927
888	788544	700227072	29.7993	9.6118	2.94841	1.12613	2789.7	619321
889	790321	702595369	29.8161	9.6154	2.94890	1.12486	2792.9	620717
890	792100	704969000	29.8329	9.6190	2.94939	1.12360	2796.0	622114
891	793881	707347971	29.8496	9.6226	2.94988	1.12233	2799.2	623513
892	795664	709732288	29.8664	9.6262	2.95036	1.12108	2802.3	624913
893	797449	712121957	29.8831	9.6298	2.95085	1.11982	2805.4	626315
894	799236	714516984	29.8998	9.6334	2.95134	1.11857	2808.6	627718
895	801025	716917375	29.9166	9.6370	2.95182	1.11732	2811.7	629124
896	802816	719323136	29.9333	9.6406	2.95231	1.11607	2814.9	630530
897	804609	721734273	29.9500	9.6442	2.95279	1.11483	2818.0	631938
898	806404	724150792	29.9666	9.6477	2.95328	1.11359	2821.2	633348
899	808201	726572699	29.9833	9.6513	2.95376	1.11235	2824.3	634760

SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, LOGARITHMS, RECIPROCALS, CIRCUMFERENCES AND CIRCULAR AREAS OF NOS. FROM 1 TO 1000

No.	Square	Cube	Sq. Root	Cu. Root	Log.	1000×Recip.	No. = Dia.	
							Circum.	Area
900	810000	729000000	30.0000	9.6549	2.95424	1.11111	2827.4	636173
901	811801	731432701	30.0167	9.6585	2.95472	1.10988	2830.6	637587
902	813604	733870808	30.0333	9.6620	2.95521	1.10865	2833.7	639003
903	815409	736314327	30.0500	9.6656	2.95569	1.10742	2836.9	640421
904	817216	738763264	30.0666	9.6692	2.95617	1.10619	2840.0	641840
905	819025	741217625	30.0832	9.6727	2.95665	1.10497	2843.1	643261
906	820836	743677416	30.0998	9.6763	2.95713	1.10375	2846.3	644683
907	822649	746142643	30.1164	9.6799	2.95761	1.10254	2849.4	646107
908	824464	748613312	30.1330	9.6834	2.95809	1.10132	2852.6	647533
909	826281	751089429	30.1496	9.6870	2.95856	1.10011	2855.7	648960
910	828100	753571000	30.1662	9.6905	2.95904	1.09890	2858.8	650388
911	829921	756058031	30.1828	9.6941	2.95952	1.09769	2862.0	651818
912	831744	758550528	30.1993	9.6976	2.95999	1.09649	2865.1	653250
913	833569	761048497	30.2159	9.7012	2.96047	1.09529	2868.3	654684
914	835396	763551944	30.2324	9.7047	2.96095	1.09409	2871.4	656118
915	837225	766060875	30.2490	9.7082	2.96142	1.09290	2874.6	657555
916	839056	768575296	30.2655	9.7118	2.96190	1.09170	2877.7	658993
917	840889	771095213	30.2820	9.7153	2.96237	1.09051	2880.8	660433
918	842724	773620632	30.2985	9.7188	2.96284	1.08932	2884.0	661874
919	844561	776151559	30.3150	9.7224	2.96332	1.08814	2887.1	663317
920	846400	778688000	30.3315	9.7259	2.96379	1.08696	2890.3	664761
921	848241	781229961	30.3480	9.7294	2.96426	1.08578	2893.4	666207
922	850084	783777448	30.3645	9.7329	2.96473	1.08460	2896.5	667654
923	851929	786330467	30.3809	9.7364	2.96520	1.08342	2899.7	669103
924	853776	788889024	30.3974	9.7400	2.96567	1.08225	2902.8	670554
925	855625	791453125	30.4138	9.7435	2.96614	1.08108	2906.0	672006
926	857476	794022776	30.4302	9.7470	2.96661	1.07991	2909.1	673460
927	859329	796597983	30.4467	9.7505	2.96708	1.07875	2912.3	674915
928	861184	799178752	30.4631	9.7540	2.96755	1.07759	2915.4	676372
929	863041	801765089	30.4795	9.7575	2.96802	1.07643	2918.5	677831
930	864900	804357000	30.4959	9.7610	2.96848	1.07527	2921.7	679291
931	866761	806954491	30.5123	9.7645	2.96895	1.07411	2924.8	680752
932	868624	809557568	30.5287	9.7680	2.96942	1.07296	2928.0	682216
933	870489	812166237	30.5450	9.7715	2.96988	1.07181	2931.1	683680
934	872356	814780504	30.5614	9.7750	2.97035	1.07066	2934.2	685147
935	874225	817400375	30.5778	9.7785	2.97081	1.06952	2937.4	686615
936	876096	820025856	30.5941	9.7819	2.97128	1.06838	2940.5	688084
937	877969	822656953	30.6105	9.7854	2.97174	1.06724	2943.7	689555
938	879844	825293672	30.6268	9.7889	2.97220	1.06610	2946.8	691028
939	881721	827936019	30.6431	9.7924	2.97267	1.06496	2950.0	692502
940	883600	830584000	30.6594	9.7959	2.97313	1.06383	2953.1	693978
941	885481	833237621	30.6757	9.7993	2.97359	1.06270	2956.2	695455
942	887364	835896888	30.6920	9.8028	2.97405	1.06157	2959.4	696934
943	889249	838561807	30.7083	9.8063	2.97451	1.06045	2962.5	698415
944	891136	841232384	30.7246	9.8097	2.97497	1.05932	2965.7	699897
945	893025	843908625	30.7409	9.8132	2.97543	1.05820	2968.8	701380
946	894916	846590536	30.7571	9.8167	2.97589	1.05708	2971.9	702865
947	896809	849278123	30.7734	9.8201	2.97635	1.05597	2975.1	704352
948	898704	851971392	30.7896	9.8236	2.97681	1.05485	2978.2	705840
949	900601	854670349	30.8058	9.8270	2.97727	1.05374	2981.4	707330

SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, LOGARITHMS, RECIPROCALS, CIRCUMFERENCES AND CIRCULAR AREAS OF NOS. FROM 1 TO 1000

No.	Square	Cube	Sq. Root	Cu. Root	Log.	1000×Recip.	No. = Dia.	
							Circum.	Area
950	902500	857375000	30.8221	9.8305	2.97772	1.05263	2984.5	708822
951	904401	860085351	30.8383	9.8339	2.97818	1.05152	2987.7	710315
952	906304	862801408	30.8545	9.8374	2.97864	1.05042	2990.8	711809
953	908209	865523177	30.8707	9.8408	2.97909	1.04932	2993.9	713306
954	910116	868250664	30.8869	9.8443	2.97955	1.04822	2997.1	714803
955	912025	870983875	30.9031	9.8477	2.98000	1.04712	3000.2	716303
956	913936	873722816	30.9192	9.8511	2.98046	1.04603	3003.4	717804
957	915849	876467493	30.9354	9.8546	2.98091	1.04493	3006.5	719306
958	917764	879217912	30.9516	9.8580	2.98137	1.04384	3009.6	720810
959	919681	881974079	30.9677	9.8614	2.98182	1.04275	3012.8	722316
960	921600	884736000	30.9839	9.8648	2.98227	1.04167	3015.9	723823
961	923521	887503681	31.0000	9.8683	2.98272	1.04058	3019.1	725332
962	925444	890277128	31.0161	9.8717	2.98318	1.03950	3022.2	726842
963	927369	893056347	31.0322	9.8751	2.98363	1.03842	3025.4	728354
964	929296	895841344	31.0483	9.8785	2.98408	1.03734	3028.5	729867
965	931225	898632125	31.0644	9.8819	2.98453	1.03627	3031.6	731382
966	933156	901428696	31.0805	9.8854	2.98498	1.03520	3034.8	732899
967	935089	904231063	31.0966	9.8888	2.98543	1.03413	3037.9	734417
968	937024	907039232	31.1127	9.8922	2.98588	1.03306	3041.1	735937
969	938961	909853209	31.1288	9.8956	2.98632	1.03199	3044.2	737458
970	940900	912673000	31.1448	9.8990	2.98677	1.03093	3047.3	738981
971	942841	915498611	31.1609	9.9024	2.98722	1.02987	3050.5	740506
972	944784	918330048	31.1769	9.9058	2.98767	1.02881	3053.6	742032
973	946729	921167317	31.1929	9.9092	2.98811	1.02775	3056.8	743559
974	948676	924010424	31.2090	9.9126	2.98856	1.02669	3059.9	745088
975	950625	926859375	31.2250	9.9160	2.98900	1.02564	3063.1	746619
976	952576	929714176	31.2410	9.9194	2.98945	1.02459	3066.2	748151
977	954529	932574833	31.2570	9.9227	2.98989	1.02354	3069.3	749685
978	956484	935441352	31.2730	9.9261	2.99034	1.02249	3072.5	751221
979	958441	938313739	31.2890	9.9295	2.99078	1.02145	3075.6	752758
980	960400	941192000	31.3050	9.9329	2.99123	1.02041	3078.8	754296
981	962361	944076141	31.3209	9.9363	2.99167	1.01937	3081.9	755837
982	964324	946966168	31.3369	9.9396	2.99211	1.01833	3085.0	757378
983	966289	949862087	31.3528	9.9430	2.99255	1.01729	3088.2	758922
984	968256	952763904	31.3688	9.9464	2.99300	1.01626	3091.3	760466
985	970225	955671625	31.3847	9.9497	2.99344	1.01523	3094.5	762013
986	972196	958585256	31.4006	9.9531	2.99388	1.01420	3097.6	763561
987	974169	961504803	31.4166	9.9565	2.99432	1.01317	3100.8	765111
988	976144	964430272	31.4325	9.9598	2.99476	1.01215	3103.9	766662
989	978121	967361669	31.4484	9.9632	2.99520	1.01112	3107.0	768214
990	980100	970299000	31.4643	9.9666	2.99564	1.01010	3110.2	769769
991	982081	973242271	31.4802	9.9699	2.99607	1.00908	3113.3	771325
992	984064	976191488	31.4960	9.9733	2.99651	1.00806	3116.5	772882
993	986049	979146657	31.5119	9.9766	2.99695	1.00705	3119.6	774441
994	988036	982107784	31.5278	9.9800	2.99739	1.00604	3122.7	776002
995	990025	985074875	31.5436	9.9833	2.99782	1.00503	3125.9	777564
996	992016	988047936	31.5595	9.9866	2.99826	1.00402	3129.0	779128
997	994009	991026973	31.5753	9.9900	2.99870	1.00301	3132.2	780693
998	996004	994011992	31.5911	9.9933	2.99913	1.00200	3135.3	782260
999	998001	997002999	31.6070	9.9967	2.99957	1.00100	3138.5	783828

STRUCTURES

The photographs following show some of the structures wherein du Mazuel reenforcements have been used to advantage and in which, in some instances, they were the only materials that could be utilized.

NEW YORK COTTON EXCHANGE

William and Beaver Streets, Borough of Manhattan

Roof of addition for cotton sampling. Made of 3 inch slabs with Standard No. 26 du Mazuel reenforcement, 13 foot spans; du Mazuel Sheets overlapped at center of spans.

George Nichols, Architect S. E. McDonald, Contractor

BRETTON HALL

Broadway and Eighty-sixth Street, Borough of Manhattan

New York City

Roof of new kitchens, 2½ inch slabs with Standard No. 26 du Mazuel reenforcement.

S. E. McDonald, Contractor

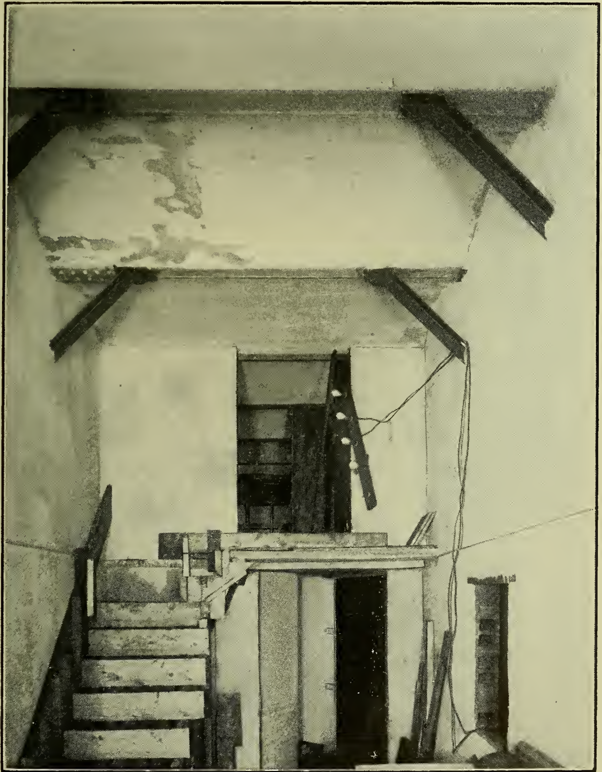
INTERBOROUGH RAPID TRANSIT COMPANY

George H. Pegram, Chief Engineer

Subway Division

Bowling Green Station, Borough of Manhattan, New York City

Extension of the station necessitated taking advantage of every inch of space and getting strongest possible construction; the Standard No. 26 du Mazuel reenforcement was therefore used in the storerooms



Storerooms Nos. 1 and 2 during construction

End storeroom and decorator's laboratory

INTERBOROUGH RAPID TRANSIT COMPANY

George H. Pegram, Chief Engineer

Elevated Division

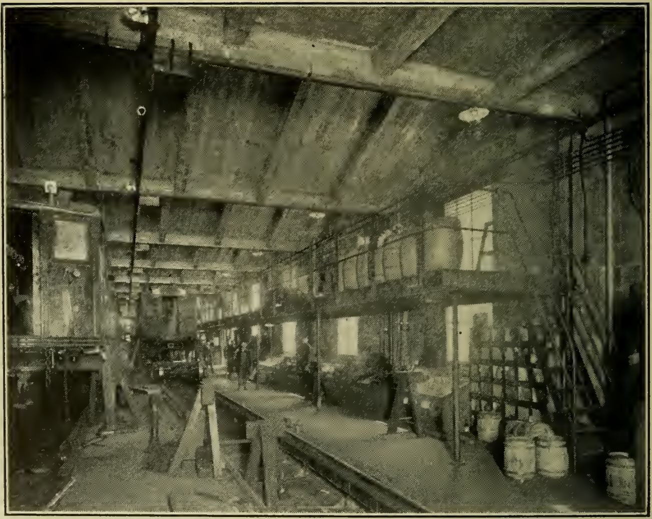
Employees' Recreation Building, Fordham, Borough of Bronx, New York City.

A happy lot of Interborough employees enjoying a quiet hour under the protection of a 2½ inch du Mazuel roof in the Fordham Recreation Building

INTERBOROUGH RAPID TRANSIT COMPANY

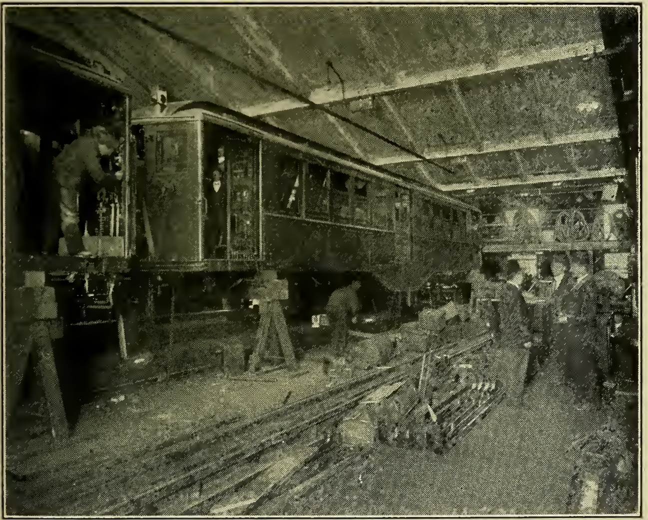
George H. Pegram, Chief Engineer

One Hundred and Twenty-ninth Street and Third Avenue Inspection Sheds and Club Rooms, Borough of Manhattan, New York City.



FRONT INTERIOR VIEW OF INSPECTION SHEDS

Floors and pits made of 2 and 3 inch slabs with Standard No. 26 du Mazuel reenforcement. An interesting experiment conducted in this shop showed that concrete cannot be used for manhole covers



REAR INTERIOR VIEW OF INSPECTION SHEDS

A study of this photograph will give an idea of the extremely heavy service to which the 2 and 3 inch du Mazuel slabs are subjected

ST. EDMUND'S CHURCH OF NEW YORK CITY

Borough of Bronx

Rev. Dr. J. C. Smiley, Rector

Dr. E. G. F. R—. du Mazuel, Engineer and Architect

This church is erected entirely in the du Mazuel system of reenforced concrete construction. Building not quite finished when Manual went to press. The complete cost of this building is less than $25,000

INTERIOR VIEW SHOWING THE NAVE OF ST. EDMUND'S CHURCH

of New York City

The high ceiling effects are hidden by the mass of decorators' scaffolding

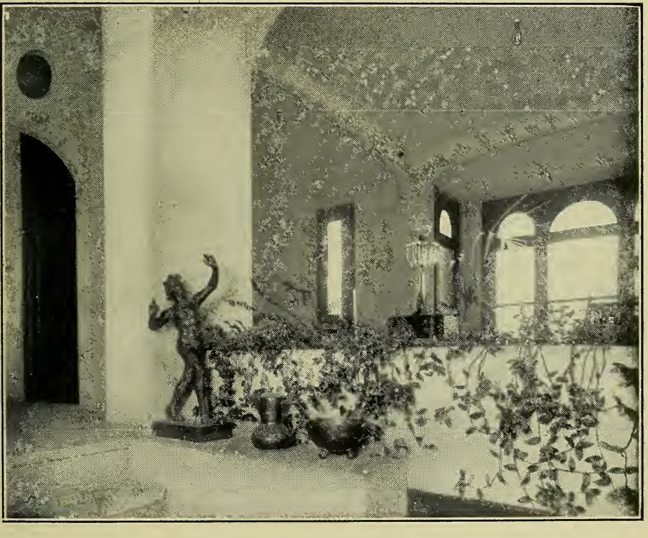
RESIDENCE AND STUDIO OF MR. AND MISS STONE

Stapleton, Staten Island

Dr. E. G. F. R—. du Mazuel, Engineer and Architect

This building is entirely of du Mazuel reenforced concrete construction. All walls are two inches in thickness.

It stands 300 feet above the sea level and is subjected at all **times** to great wind stresses.



A corner of the boudoir on second floor.

The hall and staircase from the studio

INDEX

A

B

C

C

D

E

F

F

G

H

I

J

K

L

M

N

O

P

R

R

S

S

T

U

V

W

W

NOTES