INTERNATIONAL STANDARD

ISO 3898

Second edition
1987-12-15

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION
ORGANISATION INTERNATIONALE DE NORMALISATION
МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ

Bases for design of structures — Notations — General symbols

Bases du calcul des constructions — Notations — Symboles généraux

Reference number
ISO 3898 : 1987 (E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 3898 was prepared by Technical Committee ISO/TC 98, *Bases for design of structures*.

This second edition cancels and replaces the first edition (ISO 3898 : 1976), and incorporates Addenda 1 : 1982 and 2 : 1986.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

Printed in Switzerland

Bases for design of structures — Notations — General symbols

1 Scope and field of application

This International Standard defines standard notations for structural design.

It covers only general terms which are necessary to this field of application and excludes terms relevant to a particular material (for example steel, concrete, wood, etc.) or to a special technical field (for example foundations, etc.), which are defined separately.

It indicates only the symbols to be used without prejudice to the exact definition of each term which is within the scope of other International Standards.

This International Standard has been established for use in regulations, standards, technical literature and design. It does not cover future developments in safety theories or new techniques in computer design.

However, for the time being, letter J (table 2) has been reserved for line printers and telex.

2 Types of symbol

2.1 Tables of letters and symbols

2.1.1 Table 1 gives general indications about the usage of different types of letter.

2.1.2 Tables 2, 3 and 4 give the meanings of letters when used as a main symbol.

2.1.3 Table 5 gives a list of special and mathematical symbols.

2.1.4 Tables 6, 7 and 8 give the meanings of letters or groups of letters when used as subscripts.

2.2 Construction of symbols

The construction of a symbol to represent a given quantity or term shall be carried out as follows :

1) The main letter of the symbol shall be selected from table 2, 3, 4 or 5, based on considerations of dimensions and usage, as given in table 1.

2) An apostrophe (') can be used to represent compression (especially for geometrical or locational purposes).

3) Descriptive subscripts may be selected as desired. When subscripts other than those appearing in tables 6, 7 and 8 are used, a clear definition of their meaning shall be given.

4) In the construction of symbols, the first subscripts shall indicate the location, and the following subscripts shall identify the cause (nature, location, etc.)[1].

5) When there is not likelihood of confusion, some or all descriptive subscripts may be omitted.

6) Numerical figures may be used as subscripts.

7) The sign of a computed stress is given by positive (+) for tension, and negative (−) for compression.

Owing to the possibility of confusion, the following precautions shall be taken :

— Where there is a possibility of confusing 1 (numeral) with I (letter) in some typewritten work, L shall be used in place of I (letter) where ambiguity would otherwise arise.

— Latin upper and lower case letter O shall not be used as a leading letter owing to the possibility of confusion with zero. The lower case o may, however, be used as a subscript, with the same meaning as 0 (zero).

— Greek lower case letters iota (ι), omicron (o) and upsilon (υ) shall not be used owing to the possibility of confusing them with various Latin letters. For the same reason, it is recommended that, as far as possible, the use of kappa (κ) and chi (χ) be avoided. When Greek lower case letters eta (η), omega (ω) and mu (μ) are used, care must be taken in writing the letters to avoid confusion with Latin lower case letters n, w and u.

1) Where it is necessary to avoid confusion, it is recommended that a comma be used between the two categories of subscript.

Table 1 — Letter guide for the construction of symbols

Type of letter	Dimensions	Usage
Latin upper case	Force, force times length, length to a power other than 1, temperature	1 Actions and action-effects 2 Area, first and second moments of area 3 Elastic moduli (exception to the general rule) 4 Temperature
Latin lower case	Length, quotient of length and time to a power, force per unit length or area, mass, time	1 Actions and action-effects per unit of length or area 2 Linear dimensions (length, width, thickness, etc.) 3 Strengths 4 Velocity, acceleration, frequency 5 Descriptive letters (subscripts) 6 Mass 7 Time
Greek upper case	—	Reserved for mathematics and for physical quantities excluding geometrical and mechanical quantities
Greek lower case	Dimensionless	1 Coefficients and dimensionless ratios 2 Strains 3 Angles 4 Densities (mass density and weight density) (exception to the general rule) 5 Stresses (exception to the general rule)

NOTE — Concepts not included in table 1 shall comply with the nearest appropriate category listed.

Table 2 — Latin upper case letters

Letter	Meaning
A	Area
A	*Accidental action*
B	(Void)
C	(Void)
D	Flexural rigidity of plates and shells
E	Longitudinal modulus of elasticity
E	Earthquake action
F	Action in general
F	Force in general
G	Shear modulus
G	Permanent action (dead load)
H	Horizontal component of a force
I	*Second moment of a plane area*
J	(Reserved for line printers and telex)
K	Any quantity but with a proper dimension in the absence of a specific symbol
L	Can be used for span, length of a member (see table 3)
M	Moment in general
M	Bending moment
N	Normal force
O	(To be avoided as far as possible)
P	*Prestressing force*
P	Probability (or p, see table 3)
Q (or V)	Variable action (Live load)[1), 2)]
R	Resultant force
R	Reaction force
R	Resistance
S	First moment of a plane area (Static moment)
S	Action-effect (Sollicitation)
S (or Sn)	Snow action (load) (Sn where there is a risk of confusion)
T	Torsional moment
T	Temperature
T	*Period of time*
U	(Void)
V (or Q)	Shear force[2)]
V	Volume
V	Vertical component of a force
W (or Z)	Section modulus[2)]
W	Wind action (load)
X	Force in general parallel to x-axis
Y	Force in general parallel to y-axis
Z	Force in general parallel to z-axis
Z (or W)	Section modulus[2)]

1) With a subscript if it is necessary to define an imposed load more precisely.

2) Subject to a future definite choice, either letter may be used according to existing national customs.

Table 3 — Latin lower case letters

Letter	Meaning
a	Distance
a	Acceleration
b	Width
c	(Void)
d	Diameter
d	Depth (for example foundation)
e	Eccentricity
f	Strength (of a material)[1), 2)]
f	Frequency
g	Distributed permanent action (Dead load)
g	Acceleration due to gravity
h	Height
h	Thickness
i	Radius of gyration
j	Number of days
k	Coefficient
l	Span; Length of a member[3)]
m	Can be used as bending moment per unit of length or width
m	Mass
m	Average value of a sample
n	Can be used as normal force per unit of length or width
n	Number of . . .
o	(Void)
p	Pressure
p	Probability (or P, see table 2)
q (or v)	Distributed variable action (Live load)[4), 5)]
r	Radius
s	Standard deviation of a sample
s	Spacing
s	Distributed snow action (load)
t	Time in general
t	Thickness of thin members
t	Can be used as torsional moment per unit of length or width
u	Perimeter
u, v, w	Components of the displacement of a point
v	Velocity; Speed
v (or q)	Can be used as shear force per unit of length or width[5)]
w	Distributed wind action (load)
x, y, z	Co-ordinates
z	Lever arm

1) Some countries use f with subscript for stress, but σ is recommended.

2) Some countries use σ or β with subscript for strength, but f is recommended.

3) Can be replaced by L or by l (handwritten) for some lengths or to avoid confusion with 1 (numeral).

4) With a subscript if it is necessary to define an imposed load more precisely.

5) See note 2 in table 2.

Table 4 — Greek lower case letters

Letter	Symbol	Meaning
alpha	α	Angle; Ratio
beta	β	Angle; Ratio[1)]
gamma	γ	Weight density
gamma	γ	Safety factor
gamma	γ	Shear strain[2)]
delta	δ	Coefficient of variation
epsilon	ε	Strain
xi	ξ	Relative co-ordinates x/l
eta	η	Relative co-ordinates y/l
zeta	ζ	Relative co-ordinates z/l
theta	θ	Rotation
theta	θ	Angle
iota	ι	(Void)
kappa	κ	(To be avoided as far as possible)
lambda	λ	Slenderness ratio
mu	μ	Coefficient of friction
mu	μ	Average of a population
mu	μ	Corrective factor
nu	ν	Poisson's ratio
omicron	o	(To be avoided as far as possible)
pi	π	(Mathematical use only)
rho	ϱ	Mass density
sigma	σ	Normal stress[1), 3), 4)]
sigma	σ	Standard deviation of a population
tau	τ	Shear stress[4)]
upsilon	υ	(Void)
phi	φ (ϕ)	Limiting value of angle of friction (for example for soils)
phi	φ (ϕ)	Angle
chi	χ	(To be avoided as far as possible)
psi	ψ	Relative humidity
psi	ψ	Reduction coefficient
omega	ω	Angular velocity

1) Some countries use σ or β with subscript for strength, but f is recommended (see table 3).

2) For shear strain, it is also possible to use ε with asymmetric subscripts. Example : ε_{23} or ε_{yz}.

3) Some countries use f with subscript for stress, but σ is recommended (see table 3).

4) For shear stress, it is also possible to use σ with asymmetric subscripts. Example : σ_{23} or σ_{yz}.

Table 5 — Mathematical and special symbols

Symbol	Meaning
Σ	Sum
Δ	Difference; Increment
ϕ	Diameter (for example reinforcing bar, rivets, etc.)
'(apostrophe)	Compression (especially for geometrical or locational purposes)
e	Base of Naperian logarithms : 2,718 28 . . .
π	Ratio of the circumference of a circle to its diameter : 3,141 59 . . .
n	Number of . . .
$\parallel$ or //	Parallel
$\perp$	Perpendicular, normal

Table 6 — General subscripts — Latin lower case letters[1)]

Letter	Meaning
a (or sa)	Structural steel
b (or c)	Concrete
c (or b)	Concrete
c	Compression in general
d	Design[2)]
e (or el)	Elastic limit[3)]
f	Beam flange
f	Friction
g	Guaranteed
h	Horizontal
i	Initial (in time)
i	Integer
j	Number of days
k	Characteristic
l	Longitudinal
m	Average value
m	Material
n	Net[4)]
o	Zero
o	At the origin
p (or sp)	Prestressing steel
q	(Void)
r	(Void)
s	Reinforcing steel
t	Tension in general[5)]
t	Transversal[6)]
u	Ultimate
v	Vertical
w	Web
x	Co-ordinate
y	Co-ordinate
y	Yield
z	Co-ordinate
0, 1, 2, etc.	Particular values
∞	Asymptotic value

1) Other than subscripts for actions and action-effects (see table 7) and subscripts formed from abbreviations (see table 8).

2) To be used only when there is no risk of confusion.

3) If necessary, a suitable subscript may be added or substituted in order to define the elastic limit more precisely (for example y, 0, 1, etc.).

4) If there is a risk of confusion, "net" shall be used (see table 8).

5) If there is a risk of confusion, "ten" shall be used (see table 8).

6) If there is a risk of confusion, "tra" shall be used (see table 8).

NOTE — If there is any other risk of confusion, a complete word may be used as a subscript, written in English or French.

Table 7 — Subscripts for actions, action-effects and resistances[1)]

Letter		Meaning
a	(A)	Accidental action[2)]
eq	(E)	Earthquake action
f	(F)	Action in general
f	(F)	Force in general
g	(G)	Permanent action (Dead load)
m	(M)	Bending in general
n	(N)	Normal force
p	(P)	Prestressing force
q	(Q) or v (V)	Variable action (Live load)[3), 4)]
r	(R)	Resistance
s	(S)	Action effect
s	(S)	Snow action (load)
t	(T)	Torsion in general[5)]
t	(T)	Temperature[6)]
v	(V) or q (Q)	Shear force[4)]
w	(W)	Wind action (load)

1) When it is necessary for clarification, Latin upper case letters may be used as subscripts for actions and action-effects.

2) If there is a risk of confusion, "ac" shall be used.

3) An imposed load shall be defined more precisely.

4) See note 2 to table 2.

5) If there is a risk of confusion, "tor" shall be used (see table 8).

6) If there is a risk of confusion, "tem" shall be used (see table 8).

NOTE — If there is any other risk of confusion, a complete word may be used as a subscript, written in English or French.

Table 8 — Subscripts formed from abbreviations[1)]

Letters	Meaning
abs	Absolute
adm	Admissible (Permissible)
cal	Calculated[2)]
crit (or cr)	Critical
dyn	Dynamic
ef	Effective
el (or e)	Elastic in general
est	Estimated
exc	Exceptional
ext	External
fat	Fatigue
inf	Inferior
int	Internal
lat	Lateral
lim	Limit
max	Maximum
min	Minimum
nom	Nominal
nor	Normal
obs	Observed
par	Parallel
per	Perpendicular
pl	Plastic
red	Reduced
rel	Relative
rep	Representative
ser	Serviceability
st (or stat)	Static
sup	Superior
tem	Temperature
ten	Tension
tor	Torsion
tot	Total
tra	Transversal
var	Variable

1) As far as possible, abbreviations which are not contained in this table should be derived from words having Latin roots. If there is no risk of confusion, these subscripts may be reduced to one or two letters.

2) As opposed to "observed".

Annex

Representation of notation in systems with limited character sets

(This annex forms an integral part of the Standard.)

A.1 Scope and field of application

This annex provides a means of adapting mathematical and other expressions using capital and lower case Latin and Greek letters, subscripts and certain symbols to the limited range of letters and symbols available on telex and line printers.

It concerns notations and not computer systems or computer languages. If, however, a computer output is intended to be read by persons not directly involved in the calculations nor specially informed about local practice, it should be given according to this annex. The same applies to any message given via telex.

A.2 Characters available

Generally one alphabet, A to Z (or a to z) and the figures 0 to 9 are available and in addition mostly the special signs ( ) / . , ' + − = and * where * denotes "times" and ** denotes "to the power of". The sign , is used for decimals. On the basis of these the notations are formed with J (j) given a special operational function. Where a character is not available, its name can be written out in full, e.g. APOSTROPHE (or apostrophe).

A.3 Forming Latin capitals

Latin capitals are formed from the letters available by doubling them, e.g. AA (or aa) for A, BB (or bb) for B, etc.

A.4 Forming Latin lower case letters

Latin lower case letters are formed from the letters available by taking them singly, e.g. A (or a) for a, B (or b), for b, etc.

A.5 Forming Greek lower case letters

Greek lower case letters are formed by writing two letters according to the way they are spelt in English :

α	alpha	AL or al
β	beta	BE or be
γ	gamma	GA or ga
δ	delta	DE or de
ε	epsilon	EP or ep
ζ	zeta	ZE or ze
η	eta	ET or et
θ	theta	TH or th
ι	iota	IO or io
κ	kappa	KA or ka
λ	lambda	LA or la
μ	mu	MU or mu
ν	nu	NU or nu
ξ	xi	XI or xi
o	omicron	OM or om
π	pi	PI or pi
ϱ	rho	RH or rh
σ	sigma	SI or si
τ	tau	TA or ta
υ	upsilon	UP or up
ϕ	phi	PH or ph
χ	chi	CH or ch
ψ	psi	PS or ps
ω	omega	OM or om

In certain countries some Greek lower case letters may be written as follows :

μ	mu	MY or my
ν	nu	NY or ny
υ	ypsilon	YP or yp

A.6 Forming subscripts

Subscripts are normally denoted by being preceded by J (or j), e.g. AAJB (or aajb) for A_b, CCJAL (or ccjal) for C_α, DJEF (or djef) for d_{ef},. However, in cases where the meaning is clear without it, the J (or j) may be omitted.

Where confusion can arise, the subscripts are separated by the letter J (or j) which indicates that a new subscript is to follow, e.g. DJEJF (or djejf) for $d_{e,f}$.

NOTE — Apart from use to express "to the power of", superscripts cannot be given in this notation. They can be dispensed with in practice.

A.7 Forming special symbols

Special symbols to table 5 are formed thus :

Σ	SUM (or sum)
Δ	DDE (or dde) in contrast to DE (or de) for δ
ϕ	DIA (or dia)
'	'
e	E (or e)
π	PI (or pi)
n	NUM (or num)

Example 1 :

$$\sigma = \frac{N}{A} \pm \frac{N(e_1 + e_2)}{W}$$

becomes

SI = NN/AA + −NN (EJ1 + EJ2)/WW

or

si = nn/aa + −nn (ej1 + ej2)/ww

Example 2 :

$$3{,}5\left(\sum_{i=1}^{8}(ST)_i + \alpha\right)$$

becomes

3,5 (SUM 1−8(SSTT)JI + AL)

or

3,5 (sum 1−8(sstt)ji + al)