1 GENERAL

1.1 SCOPE

The Code of Practice for the Structural Use of Steel (Limit State Approach), hereinafter referred to as "the Code", gives recommendations for the design of structural steel buildings and allied structures not specifically covered by other standards.

It does not cover all aspects of special types of steel structure such as rail or road bridges, articulated access walkways, nuclear power stations or pressure vessels. Nor does it cover structures made from fibre composites.

The Code is not intended to be used for the design of bridges, which in Hong Kong would normally be designed to the Structures Design Manual for Highways and Railways and relevant codes. However, it may be used for the design of footbridges such as those connecting buildings. In such a case, reference should also be made to the Structures Design Manual for Highways and Railways and other acceptable references.

Section 1 contains general requirements including the scope of the Code.

Section 2 describes the principles of the limit state approach used in the Code.

Section 3 covers the use of hot rolled steel sections, flats, plates, hot finished and cold formed structural hollow sections and cold formed open sections and sheet profiles conforming to acceptable international steel product standards from Australia, China, Japan, United States of America and British versions of European Union standards (i.e. European standards with British National Application Documents). These standards are listed in Annex A1. In addition to covering normally available steel with yield stresses in the range from 190 N/mm^2 to 460 N/mm^2, this section gives design recommendations on the use of high strength steel, defined as steel with yield stresses between 460 N/mm^2 and 690 N/mm^2, and uncertified steel, whereby the design strength is limited to 170 N/mm^2. The use of steels with yield strengths greater than 690 N/mm^2 is not covered in the Code.

Where other structural materials are used in association with structural steelwork, they should conform to the Hong Kong or other equivalent standards. Particular examples are, but are not limited to, Concrete, Cement Grout, Reinforcement, Stainless Steel and Aluminium.

Section 4 gives design recommendations for partial load factors in normal and extreme event load cases.

Section 5 contains particular requirements and guidance for deflection control and structural dynamics including serviceability criteria for wind induced vibration of tall buildings. The section also covers durability and protection against corrosion attack.

Recommendations for the application of "second order" methods of global analysis are provided in **Section 6**.

Design recommendations in **Sections 7, 8** and **9** cover the use of hot rolled steel sections, flats, plates, hot finished and cold formed structural hollow sections with steel grades up to yield stresses of 460 N/mm^2 and allow use of yield stresses between 460 N/mm^2 and 690 N/mm^2 subject to restrictions.

Section 10 covers the design of steel and concrete elements acting compositely, with concrete up to a design cube strength of 60 N/mm^2 and steel up to a design yield strength of 460 N/mm^2. The use of lightweight concrete is not covered in the Code.

Section 11 provides simplified guidance on the use of cold-formed thin gauge steel open sections and sheet profiles with a design yield strength up to 550 N/mm^2. The use of cold formed hollow sections and sheet pile sections are incorporated in this section.

Design recommendations for Structural Fire Engineering of steels up to yield stresses of 460 N/mm^2 are given in **Section 12**.

Section 13 provides performance-based design recommendations for various types of structure. These comprise high rise buildings, transmission towers, masts and chimneys, glass supporting structures, temporary works in construction, long span structures and footbridges. This section also contains guidance on loading from cranes and on maintenance of steel structures.

Sections 14 and 15 contain detailed guidance on fabrication and erection requirements.

The procedures for loading tests given in **Section 16** are intended only for steel structures within the scope of this Code.

Design recommendations for the evaluation and modification of existing steel structures are given in **Section 17**.

Annex A contains a list of the acceptable standards and updated references to the Building Authority for use in conjunction with the Code. Other standards or data in technical references may be used in lieu of the Code only if they can achieve a performance equivalent to the acceptable standards given in **Annex A**.

Annex B contains a method of calculating the relative strength coefficient for use in assessing the results of loading tests.

Annex C contains drawings of typical welding symbols.

Annex D contains testing to establish steel classes, essential requirements of product specifications for steel materials and bolts.

1.2 DESIGN PHILOSOPHY

1.2.1 Aims of structural design

The aims of structural design are to provide a structure with the following attributes:

a) Overall Stability against overturning, sliding, uplift or global buckling under the design loads.

b) Strength against collapse under normal loads and imposed deformations and during construction with an acceptable level of safety.

c) Integrity, ductility and robustness against abnormal loads from extreme events without suffering disproportionate collapse, in which alternative load paths may be established.

d) Fire resistance.

e) Serviceability under all normal loads and imposed deformations.

f) Durability.

g) Maintainability during its design working life.

h) Buildability.

i) Economy: The structure should fulfill the above requirements in an economic manner.

1.2.2 Design responsibility and assumptions

One appropriately qualified and experienced professional engineer, the **Responsible Engineer**, should be responsible for the design of the overall conceptual structural system including the primary vertical and lateral load paths by means of which the vertical and lateral loads are carried safely to the ground, the overall stability and the robustness and integrity to prevent disproportionate collapse. Compatibility between these systems should be ensured.

The detailed design should be carried out by qualified and competent engineers under the supervision of the Responsible Engineer.

1.2.3 Structural system, integrity and robustness

1.2.3.1 Structural system

An overall three dimensional structural system shall be designed which defines the means by which the primary vertical and lateral loads are carried safely to the ground.

1.2.3.2 Robustness, integrity and key elements

The overall structural system should be designed to be robust and able to resist disproportionate collapse. Structural integrity should be provided by tying all elements together horizontally and vertically. Particular elements of the structure that have a critical influence on overall strength or stability of the structures should be identified as key elements. These elements should be designed to resist abnormal forces arising from extreme events. The other elements should be designed to survive the removal of a non-key element by establishing alternative load paths.

1.2.4 Overall stability

Overall stability of the structure in approximately orthogonal directions shall be provided by moment resisting frame action, by bracing or by a combination of both. The bracing systems may be provided by cores. The need for diaphragm action in floors to transmit lateral forces to vertical elements shall be considered.

1.2.5 Limit State Design

Limit state design considers the functional limits of strength, stability and serviceability of both single structural elements and the structure as a whole. See clause 2.2.

Ultimate limit states consider the safety of the whole or part of the structure. Examples of ultimate limit states are **strength** including yielding, rupture, buckling and forming a mechanism, **stability** against overturning, sliding, uplift and overall lateral or torsional sway buckling, **fire** leading to deterioration of mechanical properties at elevated temperatures and thermal actions, **fracture** caused by brittle material behaviour or by fatigue.

Serviceability limit states correspond to limits beyond which specified in-service criteria are no longer met. Examples are **deflection**, wind-induced **vibration**, human-induced **vibration** and **durability**.

1.2.6 Economy

Whilst the ultimate limit state capacities and resistances given in the Code are to be regarded as limiting values, the purpose of a design should be to reach these limits in as many parts of the structure as possible, to adopt a layout such that maximum structural efficiency is attained and to rationalize the steel member sizes and details in order to obtain the optimum combination of materials and workmanship, consistent with the overall requirements of the structure.

1.2.7 Design working life

The Code assumes a design working life of 50 years. This is considered to be appropriate for normal buildings and other common structures. The design working life should be clearly identified in the design documentation.

Where a design working life of more than 50 years is required, particular requirements on design and on quality control of materials and construction will need special consideration and specification.

1.3 REFERENCES

Lists of acceptable standards and references for use in conjunction with the Code are given in Annex A1. Informative references in Annex A2 provide more detailed guidance on particular aspects of design. Annex D contains essentials of some standards where appropriate. The essentials are for guidance and ease of use of the Code. Compliance with the acceptable standards and references takes precedence over guidance given in the essentials.

The Code will accept materials that are hot rolled steel plates and sections, cold formed steel plates and sections, forgings, castings, bolts, shear studs, welding consumables to acceptable international steel product standards from five regions / countries. These are Australia, China, Japan, United States of America and British versions of European Union standards.

In order to provide a single consistent set of standards for steel materials and products, their workmanship and quality assurance procedures, such standards and procedures shall generally be defined in the Code or as given in the acceptable references in Annex A1.

In particular, references on welding, welding procedure specifications, welder qualification and testing of welds are based on current local practice. These references are given in Annex A1.4.

1.4 GLOSSARY OF TERMS AND DEFINITIONS

In the Code, the following general terms and definitions apply. They are organized in generic groups. Additional definitions of more specialized terms are given in relevant sections.

1.4.1 General definitions

acceptable standards

Standards and references acceptable to the Building Authority (BA) as given in Annex A

acceptable Quality Assurance system

a quality assurance system which is acceptable to the BA and which conforms to the requirements in ISO 9001 and Hong Kong Accreditation Service

BA

The Building Authority

B(C)R

The Building (Construction) Regulations under the Buildings Ordinance

building height

the height from assumed structural base level (where vertical and lateral loads are transmitted to the ground) to the floor of topmost storey of the structure (i.e. excluding architectural features)

Code

Code of Practice for the Structural Use of Steel 2011

dead load

characteristic dead load Gk:- any permanent structural or non-structural loads that remain throughout the service life of a structure as stated in the Building (Construction) Regulations

imposed load

characteristic imposed load Q_K:- the applied load, with the exception of dead and wind loads, likely to arise during its service life in structure as given in the Building (Construction) Regulations

wind load

characteristic wind load W_k:- the applied load as calculated in accordance with The Code of Practice on Wind Effects

pattern load

loads arranged to give the most severe effect on a particular element

factored load

characteristic or specified load multiplied by the relevant partial factor

dynamic load

part of an imposed load resulting from motion

design strength

the notional yield strength of the material used in design, obtained by applying partial factors to the specified characteristic material strength

capacity

limit of force or moment that can be resisted without failure due to yielding or rupture

CS2

Hong Kong Construction Standard 2

empirical method

simplified method of design justified by experience or by tests

GEO technical guidance documents

Geotechnical Manual, Geoguides, Geospecs, Publications, Reports and Technical Guidance Notes published by the Geotechnical Engineering Office of Civil Engineering and Development Department of the Hong Kong SAR Government

HKAS

Hong Kong Accreditation Service

HKCC

Code of Practice for Structural Use of Concrete

HKPCC

Code of Practice for Precast Concrete Construction

HKWC

Code of Practice on Wind Effects in Hong Kong

HOKLAS

Hong Kong Laboratory Accreditation Scheme

PNAP

Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers as issued from time to time by the Building Authority

1.4.2 Structural element definitions

beam

a member predominantly subject to bending

cantilever

a beam that is fixed at one end and free to deflect at the other

column

a vertical member predominantly carrying axial force and possibly moments

mega column

very large column, typically used for outrigger or externally braced tube in high rise structures

strut

member carrying predominantly axial compressive force

foundation

part of a structure that distributes load directly to the ground

portal frame

a single storey frame with rigid moment-resisting joints

sub-frame

part of a larger frame

segment

a portion of the length of a member, between adjacent points that are laterally restrained

transverse

direction perpendicular to the stronger of the rectangular axes of the member

torsional restraint

restraint that prevents rotation of a member about its longitudinal axis

1.4.3 Structural behaviour definitions

buckling resistance

limit of force or moment that a member can withstand without buckling

effective length for a beam

length between adjacent restraints against lateral-torsional buckling, multiplied by a factor that allows for the effect of the actual restraint conditions compared to a simple beam with torsional end restraint

effective length for a compression member

length between adjacent lateral restraints against buckling about a given axis, multiplied by a factor that allows for the effect of the actual restraint conditions compared to pinned ends

elastic analysis

structural analysis that assumes no redistribution of moments in a continuous member or frame due to plastic hinge rotation

elastic critical load

load at which perfect element or structure becomes elastically unstable

global imperfection

geometric out-of-plumbness of structural system

global stability

stability of overall structure against buckling, overturning, uplift and sliding

instability

inability to carry further load due to vanishing stiffness

lateral restraint for a beam

restraint that prevents lateral movement of the compression flange

lateral restraint for a compression member

restraint that prevents lateral movement of the member in a given plane

local stability

stability of element or part of element against buckling

member imperfection

inherent out-of-straightness of structural member

plastic analysis

structural analysis that allows for redistribution of moments in a continuous member or frame due to plastic hinge rotation

plastic load factor

the ratio by which each of the factored loads would have to be increased to produce a plastic hinge mechanism

plastic moment

moment capacity allowing for redistribution of stress within a cross-section

second order analysis

analysis of structures involving the tracing of the equilibrium or the load versus deflection path up to the formation of first plastic hinge with consideration of initial member imperfections

slenderness

the effective length divided by the radius of gyration

stability

resistance to failure by buckling or loss of static equilibrium

1.4.4 Material behaviour definitions

brittle fracture

brittle failure of steel at low temperature

ductility

ability of a material to undergo plastic deformations

fatigue

damage to a structural member caused by repeated application of stresses that are insufficient to cause failure by a single application

strength

resistance to failure by yielding or buckling

1.4.5 Section type definitions

built-up

constructed by interconnecting more than one rolled section to form a single member

compact cross-section

a cross-section that can develop its plastic moment capacity, but in which local buckling prevents rotation at constant moment

compound section

sections, or plates and sections, interconnected to form a single member

H-section

section with a central web and two flanges, that has an overall depth not greater than 1.2 times its overall width

hybrid section

section with a web or webs of lower strength grade than that of the flanges

I-section

section with a central web and two flanges, that has an overall depth greater than 1.2 times its overall width

plastic cross-section

a cross-section that can develop a plastic hinge with sufficient rotation capacity to allow redistribution of bending moments within a continuous member or frame

semi-compact cross-section

a cross-section that can develop its elastic capacity in compression or bending, but in which local buckling prevents development of its plastic moment capacity

slender cross-section

a cross-section in which local buckling prevents development of its elastic capacity in compression and/or bending

welded section

cross-section fabricated from plates by welding

1.4.6 Connection definitions

connection

location where a member is fixed to a supporting member or other support, including the bolts, welds and other material used to transfer loads

edge distance

distance from the centre of a bolt hole to the nearest edge of an element, measured perpendicular to the direction in which the bolt bears

end distance

distance from the centre of a bolt hole to the edge of an element, measured parallel to the direction in which the bolt bears

friction grip connection

a bolted connection that relies on friction to transmit shear between components

joint

element of a structure that connects members together and enables forces and moments to be transmitted between them

notched end

connected end of a member with one or both flanges cut away locally

preloaded bolt

bolt tightened to a specified initial tension, sometimes called High Strength Friction Grip or HSFG bolt

rotation capacity

the angle through which a joint can rotate without failing

rotational stiffness

the moment required to produce unit rotation in a joint

slip resistance

limit of shear that can be applied before slip occurs in a friction grip connection

1.5 MAJOR SYMBOLS

A	Cross-sectional area of the beam
A_c	Cross-sectional area of the concrete section of the column
	or Net sectional area of the connected leg
A_{cv}	Mean cross-sectional area, per unit length of the beam of the concrete shear surface under consideration
A_e	Effective net area of a section or a sheet profile (for tension or compression)
A_{eff}	Effective cross-sectional area (for tension or compression)
A_g	Gross cross-sectional area
A_n	Net area
A_{net}	Effective net area of a section or a sheet profile
A_p	Cross-sectional area of the profiled steel sheeting
A_s	Shear area of a bolt
A_{sv}	Cross-sectional area per unit length of the beam of the combined top and bottom reinforcement crossing the shear surface
A_t	Tensile stress area of a bolt
A_u	Gross sectional area of the unconnected leg or legs
A_v	Shear area of a member
$A_{v,eff}$	Effective shear area
$A_{v,net}$	Net shear area after deducting bolt holes
A_1	Loaded area under the gusset plate

B	Width or breadth of section
B_c	Width of the compression flange
B_e	Total effective breadth of the concrete flange
B_f	Width of the flange for flange curling
B_s	Width of the composite slab
B_t	Width of the tension flange
C	Distance from the end of the section to the load or the reaction
C_w	Warping constant for the cross-section
D	Depth of section
	or Diameter of section
	or Diameter of hole
D_p	Overall depth of the profiled steel sheet
D_s	Depth of concrete flange
E	Modulus of elasticity
E_{cm}	Short-term elastic modulus of the normal weight concrete
$(EI)_e$	Effective flexural stiffness
F	Local concentrated load or reaction between the points of interconnection under consideration
F_L	Longitudinal shear parallel to axis of the weld
F_T	Resultant transverse force perpendicular to axis of the weld
F_N	Notional horizontal force
F_V	Factored dead plus live loads on and above the floor considered
F_w	Concentrated force
F_a	End anchorage force per shear connector
	or Compression axial force
F_b	Beam longitudinal shear force per shear connector
F_c	Axial compression
F_n	Longitudinal compressive force in the concrete slab at the point of maximum negative moment
F_p	Longitudinal compressive force in the concrete slab at the point of maximum positive moment
F_t	Applied tensile load
F_{tot}	Total applied tension in bolt
F_{nom}	Nominal tension capacity of the bolt
G	Shear modulus
G_k	Characteristic dead load
H	Warping constant of section
I	Second moment of area of the structural steel cross-section about the critical axis
I_{CA}	Second moment of area of the composite slab about its centroidal axis
I_{CS}	Second moment of area for the cracked section
I_{GS}	Second moment of area for the gross section
I_c	Second moment of area of the un-cracked concrete section
I_e	Second moment of area of the effective cross section
I_g	Second moment of area for the gross section
I_{min}	Minimum value of second moment of area of an edge stiffener about an axis through the mid-thickness of the element to be stiffened

I_n	Second moment of area for the cracked section value under negative moments
I_p	Second moment of area for the cracked section value under positive moments
I_s	Second moment of area of the reinforcement
I_{ser}	Second moment of area of the profiled sheets at serviceability limit state
I_x	Second moment of area about the major axis
I_{xg}	Second moment of area of the gross section
$I_{xr,h}$	Second moment of area of the effective section under hogging moment due to serviceability load
$I_{xr,s}$	Second moment of area of the effective section under sagging moment due to serviceability load
I_y	Second moment of area about the minor axis
J	St. Venant's torsion constant
K	Buckling coefficient
L	Span between end supports
	or Length
L_E	Effective length
L_j	Distance between the centres of two end bolts
L_p	Effective span of the profiled steel sheets
L_s	Effective span of the composite slab
L_v	Shear span
L_z	Effective span
M	Bending moment
M_E	Elastic lateral buckling resistance moment
M_Y	Elastic yield moment of the section
M_b	Buckling moment resistance
M_c	Moment capacity
M_{co}	Plastic moment capacity of the composite cross-section with partial shear connection
M_{cr}	Critical bending moment
M_{cv}	Reduced plastic moment capacity of the composite cross-section under high shear force
M_{cx}	Elastic moment capacity about the major principal x-axis
M_{cy}	Elastic moment capacity about the minor principal y-axis
M_f	Plastic moment capacity of that part of the section remaining after deduction of the shear area A_v
M_o	Maximum moment in the simply supported beam
M_{cp}	Moment capacity of a doubly symmetric composite cross-section
$M_{cp,P}$	Moment capacity of composite cross-section taking account the axial force
M_s	Moment capacity of steel section
M_x	Maximum design moment amplified for the P-Δ-δ effect about the major x-axis
M_y	Maximum design moment amplified for the P-Δ-δ effect about the minor y-axis
M_1 , M_2	Moments at the adjacent supports
$\overline{M}_x$	Maximum first-order linear design moment about the major x-axis

$\overline{M}_y$	Maximum first-order linear design moment about the minor y-axis
$\overline{M}_{LT}$	Maximum design moment about the major x-axis governing M_b
N	Number of shear connectors attached to the end of each span of sheets per unit length of supporting beam
N_b	Length of stiff bearing
N_i	Total number of shear connectors between any such intermediate point and the adjacent support
N_n	Number of shear connectors required to develop the negative moment capacity
N_p	Number of shear connectors required to develop the positive moment capacity
P	Design compressive normal force in the composite column
	or Either P_p or P_n for shear connectors resisting positive or negative moments respectively
P_E	Minimum elastic buckling load
P_{Ex}	Elastic flexural buckling load for a column about the x axis
P_G	Part of this normal force that is permanent
P_L	Permissible capacity per unit length of weld in the longitudinal direction
P_T	Permissible capacity per unit length of weld in the transverse direction
	or Torsional buckling load of a column
P_{TF}	Torsional flexural buckling load of a column
P_a	End anchorage capacity per shear connector
P_b	Capacity per shear connector for composite beam design
P_{bb}	Bearing capacity of a bolt
P_{bg}	Friction grip bearing capacity
P_{bs}	Bearing capacity of connected parts
P_{bw}	Bearing capacity of unstiffened webs
P_c	Compressive buckling resistance
P_{cs}	Compressive capacity of a member
P_{cx}	Compression resistance under sway mode and about the x-axis
P_{cy}	Compression resistance under sway mode and about the y-axis
P_{cp}	Compression capacity of a composite cross-section
$P_{cp,k}$	Characteristic value of the compression capacity
$P_{cp,cr}$	Critical buckling load for the relevant axis and corresponding to the effective flexural stiffness
P_k	Characteristic resistance of the shear connector
P_n	Resistance of shear connectors against longitudinal shear for negative moments
P_o	Minimum proof loads of bolts
P_p	Resistance of shear connectors against longitudinal shear for positive moments
P_s	Shear capacity of bolts
	or Stiffener capacity
P_{sL}	Slip resistance provided by a preloaded bolt
P_t	Tension capacity of bolts
P_w	Web crushing capacity of a single web
P_x	Buckling resistance of unstiffened webs

$\overline{P}_c$	Smaller of the axial force resistance of the column about x- and y-axis under non-sway mode and determined from a second-order analysis or taking member length as the effective length
Q_k	Characteristic imposed load
Q_{ult}	Ultimate design loads
R_c	Resistance of concrete flange
$R_{e.min}$	Specified yield strength of profiled steel sheets
R_{eH}	Upper yield strength
$R_{p\ 0.2}$	0.2% proof stress
$R_{t\ 0.5}$	Stress at 0.5% total elongation
R_m	Minimum tensile strength
R_q	Resistance of shear connection
R_r	Resistance of the reinforcement
R_s	Resistance of steel beam
R_v	Resistance of the clear web depth
R_{ult}	Ultimate design resistance
S	Plastic modulus
	or Fatigue strength of the joint
S_B	Fatigue strength of the same joint using basic design curve
S_v	Plastic modulus of shear area
S_{eff}	Effective plastic modulus
S_{ult}	Ultimate design load effects
S_x	Plastic modulus about the major axis
S_y	Plastic modulus about the minor axis
S_p, S_{ps}, S_{pc}	Plastic section moduli for the steel section, the reinforcement and the concrete of the composite cross-section respectively
S_{pn}, S_{psn}, S_{pcn}	Plastic section moduli of the corresponding components within the region of 2 h_n from the middle line of the composite cross-section
T	Flange thickness
T_C	Thickness of connected flange
U_b	Specified minimum tensile strength of bolts
U_e	Minimum tensile strength of the electrode
U_s	Specified minimum tensile strength of the parent metal
V	Applied shear force
V_c	Shear capacity of a member
V_{cr}	Critical shear buckling resistance of a web
V_{crit}	Strouhal critical wind velocity
V_p	Punching shear capacity of a composite slab
V_s	Shear-bond capacity of composite slab
V_v	Vertical shear capacity of composite slab
V_w	Shear buckling resistance of a web
$\overline{V}_c$	Total longitudinal shear capacity per unit width of slab
$\overline{V}_s$	Shear bond capacity per unit width
W	Total factored load
W_{ser}	Serviceability loads
Y_{sa}	Average yield strength

Y_f	Specified minimum yield strength of bolts
Y_s	Yield strength
Z	Elastic modulus
Z_c	Elastic modulus of the gross cross-section with respect to the compression flange
Z_{eff}	Effective section modulus
Z_r	Elastic modulus of the section after deduction for the notched material
Z_x	Section modulus about the major axis
Z_y	Section modulus about the minor axis
a	Distance between centres of holes
	or Spacing of transverse stiffeners
	or Effective throat size of weld
a_e	Effective area of element for tension
b	Flat width of the compression flange
	or Outstand
b_a	Mean width of a trough of an open profile
b_b	Minimum width of a trough of a re-entrant profile
b_e	Effective breath of concrete flange
	or Effective width of a flat element
b_{eu}	Effective width of a flat unstiffened element
$b_{e,1}$	Portion of the effective width adjacent to the more compressed edge
$b_{e,2}$	Portion of the effective width adjacent to the less compressed edge
$b_{e,3}$	Portion of the effective width adjacent to the tension edge
$b_{e,ser}$	Effective width for a stiffened or an unstiffened flat flange element
$b_{e,1,ser}$	Portion of the effective width adjacent to the more compressed edge
$b_{e,2,ser}$	Portion of the effective width adjacent to the less compressed edge
$b_{e,3,ser}$	Portion of the effective width adjacent to the tension edge
b_d	Developed width of the stiffened element
b_{fc}	Width of the flange for flange curling
b_r	Breadth of the concrete rib
b_t	Portion of the web under tension
c_n	Nominal value of concrete cover
$c_{n,min}$	Minimum concrete cover
d	Diameter of headed shear studs
	or Diameter of a bolt
	or Depth of web
d_e	Distance from the centre of a bolt to the end of the connected element in the direction of the bolt force
d_n	Depth of the neutral axis from the middle line of the cross-section
d_p	Diameter of the perforation
d_s	Effective depth of slab to the centroid of profiled steel sheets
d_w	Web depth or sloping distance between the intersection points of a web and the flanges
e	Edge or end distance
e_s	Distance between the neutral axis of the gross cross-section and that of the effective cross-section

e_{sc}	Distance from the shear centre to the centroid measured along the x axis
f_a	Average stress in the flange
f_c	Applied compressive stress
f_{cd}	Design strengths of the concrete
f_{cu}	Cube compressive strength of concrete
$f_{c,1}$	Larger compressive edge stress
$f_{c,2}$	Smaller compressive edge stress
$f_{c,1,ser}$	Larger compressive edge stress due to serviceability loading
$f_{c,2,ser}$	Smaller compressive edge stress due to serviceability loading
f_{sd}	Design strengths of steel reinforcement
f_{ser}	Compressive stress in the effective element under serviceability loading
f_u	Ultimate strength of stud material before cold-drawn
f_v	Shear stress
f_y	Characteristic strength of steel reinforcement
g	Gauge length
g_k	Specified dead load per unit area of the floor or roof
h	Depth of the column section
	or Overall height of headed shear studs
	or Storey height
k	Shape correction factor
k_r	Empirical parameter
k_{sc}	Degree of shear connection
m	Equivalent uniform moment factor
m_r	Empirical parameter
m_x, m_y	Equivalent uniform moment factor for flexural buckling about x- and y-axis
m_{LT}	Equivalent moment factor for lateral-flexural buckling
p_b	Bending strength (lateral-torsional buckling)
p_{bb}	Bearing strength of a bolt
p_{bs}	Bearing strength of connected parts
p_c	Compressive strength
p_{cr}	Local buckling strength of the element
p_{ed}	Compressive strength for edge loading
$p_{r,cr}$	Elastic critical buckling strength
p_s	Shear strength of bolts
p_t	Tension strength of a bolt
p_v	Average shear strength
p_w	Design strength of a fillet weld
p_y	Design strength of the structural steel section
p_{yf}	Design strength of the flange
p_{yp}	Design strength of the pin
p_{yr}	Design strength reduced for slender sections
p_{ys}	Design strength of stiffener
p_{yw}	Design strength of the web
g_k	Specified imposed floor or roof load per unit area
q_w	Shear buckling strength of a web

r	Ratio of the mean longitudinal stress in the web to the design strength
	or Internal radius of corner
r_l	Radius of gyration of the compound section about the axis parallel to the webs based on nominal geometric properties
r_{cy}	Minimum radius of gyration of an individual section
r_o	Polar radius of gyration about the shear centre
	or Limiting radius of effective corners
r_x	Radius of gyration about the major axis
r_y	Radius of gyration about the minor axis
s	Longitudinal spacing between adjacent interconnections
	or Distance between centres of bolts normal to the line of force
	or Leg length of a fillet weld
s_p	Staggered pitch
s_r	Semi-perimeter of the stiffener
s_t	Transverse spacing centre-to-centre of the studs
	or Mean transverse spacing of the ties
t	Web thickness
t_B	Maximum thickness relevant to the basic curve
t_c	Stem of connected structural member
t_e	Effective thickness in the perforated zones
t_f	Column flange thickness
t_p	Thickness of the profiled steel sheet
	or Thickness of a connected part
t_w	Column web thickness
t_3	Thickness of the member in contact with the screw head or the preformed rivet head
t_4	Thickness of the member remote from the screw head or the preformed rivet head
w	Load intensity on the beam acting on a bearing length of $s/2$ each side of the interconnections under consideration
u	Buckling parameter of a cross-section
v	Total longitudinal shear force per unit length
	or Slenderness factor for a beam
v_c	Design concrete shear stress
v_p	Contribution of the profiled steel sheeting in resisting transverse shear force
v_r	Effective transverse shear resistance of profiled steel sheeting
v_1	Value of v_r for ribs perpendicular to the span
v_2	Value of v_r for ribs parallel to the span
x	Torsional index of a cross-section
x_c	Depth of concrete in compression at mid-span
y	Distance from the flange to the neutral axis
z	Lever arm
α_e	Effective modular ratio
α_L	Modular ratio for long term loading
α_s	Modular ratio for short term loading
α_{TF}	Torsional flexural buckling parameter
β	Equivalent moment factor

	or *R*atio of the smaller end moment to the larger end moment *M* in the unbraced length of a section
γ_a	Partial safety factor of steel section
γ_c	Partial safety factor of concrete
γ_f	Load factor
γ_{m1}	Partial material factor for minimum yield strength of steel material
γ_{m2}	Partial material factor for minimum tensile strength of steel material
γ_s	Partial safety factor of steel reinforcement
δ	Steel contribution ratio
δ_N	Notional horizontal deflection of the upper storey relative to the lower storey due to the notional horizontal force
δ_c	Deflection of a continuous beam at mid-span
	or Deflection of a composite beam with full shear connection
δ_s	Deflection of the steel beam acting alone
δ_0	Deflection of a simply supported beam for the same loading
ε	$(275/p_y)^{0.5}$
α	Perry coefficient
	or Coefficient of linear thermal expansion
α_L	Modular ratio for long term loading
α_s	Modular ratio for short term loading
λ	Relative slenderness
λ_{cr}	Elastic critical load factor
λ_{eff}	Effective slenderness ratio
λ_{L0}	Limiting equivalent slenderness (lateral-torsional buckling)
λ_{LT}	Equivalent slenderness (lateral-torsional buckling)
λ_w	Web slenderness
λ_0	Limiting slenderness (axial compression)
$\bar{\lambda}$	Relative slenderness for the plane of bending being considered
μ	Moment resistance ratio obtained from the interaction curve
μ_d	Reduction factor for moment resistance in the presence of axial force
ρ_L	Proportion of the total loading which is long term
φ_t	Creep coefficient
χ	Reduction factor for the relevant buckling mode
χ_{pm}	Axial resistance ratio due to the concrete
χ_d	Design axial resistance ratio
Δ	Deflection for the given loading system
Δ_c	Deflection corresponding to M_c calculated using the reduced cross-section
Δ_{cr}	Deflection of the beam corresponding to M_{cr} calculated using the full cross-section
ν	Poisson's ratio
τ	Design shear strength
Ω	Arching ratio

Diagrams of typical welding symbols are given in Annex C.