NOMENCLATURE FOR COMPOSITE STEEL
AND CONCRETE BEAMS

Report to ASCE-ACI Committee on Composite Construction

Subcommittee III--Terminology of Composite Construction

Prepared by

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and

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This report gives preliminary suggestions for a list of
nomenclature for composite beams consisting of a steel beam
supporting a concrete slab with some sort of shear connection
supplied to transmit shear between the steel and concrete
sections. The list is intended to cover those properties which
are common to all composite beams of this type. There are
undoubtedly additional properties arising in individual designs
which might have been included in this list. However, for
brevity many of these are omitted.

Wherever possible the usages of the American Concrete
Institute[1] have been followed in this report when considering
concrete. Terms used by the American Institute of Steel
Construction [4,5,8] have been used where steel alone is con-
cerned. Because of its reasonably complete coverage of the
subject of composite beams there is also much nomenclature
taken from the specification of the American Association of
State Highway Officials. In this list an attempt has been made
to set up a nomenclature which does not clash too seriously

with either of the existing basic systems but which will allow
nomenclature to be handled effectively when both materials
are used together as in composite beams.

The list has been broken into five (5) basic sections:

1. Geometric properties of members

2. Physical properties of materials

3. Loads, forces, stresses and moments

4. Geometric terms used in stress analysis

5. Terms related to shear connectors

Within these basic sections wherever applicable, separate
lists are shown for the steel and the concrete nomenclature.
In some cases also nomenclature referring to the complete com-
posite beam is listed separately. Following each entry in
the nomenclature is a reference number referring to the list
of references and designating the reference from which the
specific term was selected. Also, accompanying each definition
is a designation of the units in which this term would be ex-
pressed. These units are designated by expressions "F" for
force and "L" for length.

This list of nomenclature is suggested as a basis for the
committee to begin its preparation of a more complete list.
It is probable that once the complete list is agreed upon it
would also be worthwhile to make a single list in alphabetical
order to enable individual symbols to be located more quickly.

NOMENCLATURE

Units

I. Geometric Properties of Members

Steel Beam

A_b = area of bottom flange of steel member[7] (L^2)

A_p = area of cover plate [7] (L^2)

A_s = total area of steel member [1] (L^2)

A_t = area of top flange of steel member [7] (L^2)

A_w = area of web of steel member [7] (L^2)

d = depth of steel member [4] (L)

Concrete Slab

A_c = transformed area of concrete slab [3] (L^2)

A_s^0 = area of steel slab reinforcement [1] (L^2)

b = width of concrete slab [2] (L)

Composite Beam

d_c = depth of composite section [0] (L)

L = span length center to center of bearing [1] (L)

II. Physical Properties of Materials

Concrete

E_c = modulus of elasticity of concrete [1] (F/L^2)

f_c^0 = compressive strength of concrete at age (F/L^2)
        28 days [1]

Steel

(E) E_s = modulus of elasticity of steel [1] (F/L^2)

(F_y) f_y = yield stress of steel member [5] (F/L^2)

n = ratio E_s divided by E_c [2]   (-)

Units

III. Loads, Forces, Stresses and Moments

C = total compressive force in the concrete   (F)

        slab [2]

C^0 = total compressive force in the steel   (F)

        member [0]

f_c = stress in concrete [1]   (F/L^2)

(F_b) f_s = stress in steel [2]   (F/L^2)

M_D = moment due to dead load which is applied   (FL)

        before concrete   reaches 75% of f_c^0 [2]

M_L = moment due to live load and superimposed   (FL)

        dead load [2]

M_p = plastic moment of the steel member [5]   (FL)

M_u = ultimate moment of composite section [1]   (FL)

T = total tensile force [2]   (F)

v = horizontal shear force per unit length of   (F/L)

        beam [2]

V = total shear force [2]   (F)

IV. Geometric Terms used in Stress Analysis

a = depth of compressive stress block at   (L)

        ultimate moment [1]

e = distance between resultant compressive and   (L)

        tension forces at ultimate moment [2]

I = moment of inertia of steel section [4]   (L^4)

(I_{tr}) I_c = moment of inertia of composite section [7]   (L^4)

L_s = distance between sections at which ultimate   (L)

        moment and zero moment occur [3] (shear span)

Q = static moment of transformed concrete area $\quad$ (L³)

about the neutral axis of the composite

member [2]

(S_s) $\quad$ S = section modulus of steel beam [4] $\quad$ (L³)

S_b = section modulus of composite section

referred to bottom[0]

S_t = section modulus of composite section $\quad$ (L³)

referred to top of concrete slab [0]

y_b = distance from neutral axis of composite $\quad$ (L)

section to bottom of steel section [0]

(c) $\quad$ y_t = distance from neutral axis of composite $\quad$ (L)

section to top of concrete slab [0]

Z = plastic modulus of steel section [5] $\quad$ (L³)

Z_c = plastic modulus of composite section [0] $\quad$ (L³)

V. Terms Related to Shear Connectors

d_s = diameter of shear connector stud or spiral [2] $\quad$ (L)

f_s^0 = ultimate strength of shear connector $\quad$ (F/L²)

material

(t_f) $\quad$ h = maximum flange thickness of channel shear $\quad$ (L)

connector [2]

H = height of stud shear connectors [0] $\quad$ (L)

q = resistance value of one shear connector $\quad$ (F)

at working load [2]

q_u = ultimate strength of one shear connector [0] $\quad$ (F)

                                                                      Units

s   = spacing of shear connectors [2]   (L)

t   = web thickness of channel shear connector [2]   (L)

w   = length of channel shear connector [2]   (L)

Symbols in parentheses refer to corresponding symbol used in the 1961 AISC Specifications [8] if different than the symbol selected here.

Numerals following each definition refer to the reference number from the list of references.

REFERENCES

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LEHIGH UNIVERSITY
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Department of Civil Engineering
Fritz Engineering Laboratory

279   March 7, 1962

Mr. A. M. Lount
Lount and Associates
164 Eglinton Avenue, E.
Toronto 12, Canada

Dear Mr. Lount:

        In answer to your letter of February 6, 1962, I
am transmitting to you a brief report suggesting
nomenclature for composite steel and concrete beams.
This report is also transmitted to the other members
of the subcommittee on nomenclature. I hope it may
serve as a jumping off point from which to begin pre-
paration of the complete nomenclature. I will now
await your suggestions to myself and the other members
of the subcommittee as to further action to be taken
on this suggested nomenclature.

                              Sincerely yours,

                              George C. Driscoll, Jr.
GCD:lm

Encl.

cc: Messrs: I. A. Benjamin
            N. W. Hanson
            P. Page, Jr.
            T. R. Higgins