FEASIBILITY OF USING COLD FORMED STEEL

FOR

MEDIUM SPAN ROOF STRUCTURES

IN SRI LANKA

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Declaration

"I declare that the work contained in this thesis has not been previously submitted for a degree or diploma at any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

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Abstract

Cold formed steel members have been widely used in industrial and commercial buildings over the world with increasing interest and even in the residential development. In the past it was used mostly in non-load bearing structural systems that is partition and architectural feature elements, but it is now used even in the structural systems, and are effective in reducing the self-weight of structure.

Cost of Construction around various parts of the world depends on various factors based on the structural category, availability of material, labour cost, material cost, technology available and use, serviceability limit requirements and standard structural design requirements, so on. Therefore light weight structure itself would not be an effective solution for every construction and structural system. Steel construction industry in Sri Lanka; mostly depends on hot rolled steel member / section for their structural solution. The other type of steel; that is cold formed sections / members available for construction, is very uncommon as a structural element, but it is still using as purlin, for steel roof structures. Feasibility of using cold formed steel in structural roof system has not been specifically studied yet, and construction industry is still waiting for such a detail study to overcome the excessive cost of steel construction in Sri Lanka.

This research is based on the 4-case studies, that were already completed using hot rolled steel members for its structural roof system, contain 4.0m, 8.0m, 10.0m, & 12.0m span parallel girder trusses and pitched trusses. Bay spacing for selected cases were pre-defined according to the column grid of the particular building and was 3.0m, 4.0m, 3.2m, and 6.0m respectively. Under this study, aforesaid roof structures were totally replaced by cold formed steel system (lipped channel sections), and checked the structural ability to reach the design requirements followed by ultimate limit state and serviceability limit state, under feasible limit of cost.

Detail comparison for roof structures were carried out and feasibility of using cold formed steel was studied. It was shown that, for medium span roof structures between ranges of 8.0m to 10.0m could gain a saving of 23% ~ 25% of total cost of roof construction cost. Therefore, uses of cold formed steel (CFS), for structural roof systems under medium scale construction is recommended with minimum saving of 20% of construction cost.

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NOTATION

A Area or Gross area of a cross-section

A_e Effective net area of a section

A_{eff} Effective area

A_n Net area of a section

A_{st} Area of an intermediate stiffener

A_t Tensile stress area of a bolt

a Effective throat size of a fillet weld

a_1 Net sectional area of connected elements

a_2 Gross sectional area of unconnected elements

B Overall width of an element

B_f Half the overall flange width of an element

b Flat width of an element

b_{eff} Effective width of a compression element

b_{er} Reduced effective width of a sub-element

b_{eu} Effective width of an unstiffened compression element

C_W Warping constant of a section

c Distance from the end of a beam to the load or the reaction

d Overall web depth of lip Channel

b_2 Overall width of lip channel

b_3 Depth of lip for lip channel

d Diameter of a bolt

E Modulus of elasticity of steel

F_t Applied tensile load

F_c Applied axial compressive load

g Gauge, i.e. distance measured at right angles to the direction of stress in a member, centre-to-centre of holes in consecutive lines

h Vertical distance between two rows of connections in channel sections

I Second moment of area of a cross-section about its critical axis

I_{min} Minimum required second moment of area of a stiffener

I_x, I_y Second moment of area of a cross-section about the x and y axes respectively

J St Venant torsion constant of a section

K Buckling coefficient of an element

L Length of a member between support points

L_E Effective length of a member

M Applied moment on a beam

M_b	Buckling resistance moment
M_c	Moment capacity of a cross-section
M_{cr}	Critical bending moment causing local buckling in a beam
M_{cx}	Moment capacity in bending about the x axis in the absence of Fc and My
M_{cy}	Moment capacity in bending about the y axis in the absence of Fc and Mx
M_x, M_y	Moment about x and y axes respectively
P_{bs}	Bearing capacity of a bolt
P_c	Buckling resistance under axial load
V	basic wind speed
V_s	design wind speed
h	height of building structure
w	width of building
q	dynamic pressure of wind (stagnation pressure)
S_1	topography factor
S_2	ground roughness, building size and height above ground factor
S_3	a statistical factor