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Critical Reviews on Design and Analysis of Stiffened Rectangular Hollow Cantilever Beam

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Abstract

Hollow Cantilever beam are used widely in offshore, Bridges, steel structural and heavy duty machine normally used in cranes like Telescopic boom crane. During the loading and unloading operation some concentrated load and self-weight applied on the beam. This is produce bending and buckling moment and shear force in planes. Design engineers have great challenge to provide the better robust design of beam which can withstand applied load with optimize design. From the literature survey strengthening of beam or plate are provided by applying transvers or/and longitudinal stiffeners which can withstand post buckling and lateral buckling moment. Thus, it is very much necessary for the designers to provide not only a better design of parts having maximum reliability but also of minimum weight and cost, keeping design safe under all loading conditions. Presented paper focuses on work done carried out by other researches in the same era, and found that number of stiffeners and its locations and its dimensional property affect the behaviour of beam strength.

Keywords: *Transvers stiffener, cantilever beam, RHS, Mohr's moment theory, FEA*

Notation

τ	Shear stress (N/mm^2)	K	Torsional parameter
V	Shear load (N)	y_q	Load height below shear centre (mm)
$t_{(y)}$	Sectional width at the distance y from the N.A.(mm)	υ	Poisson ratio
d, h	Depth of Beam (mm)	I_y	Second moment of inertia at y axis as neutral (mm^4)
f_y	Yield stress of material (N/mm^2)	I_z	Second moment of inertia at z axis as neutral (mm^4)
Q	End load (N)	K	Shear coefficient
q	Distributed load per unit length (N/mm)	2a	Depth of beam (mm)
L	Distance from the moment location to the point load(mm)	2b	Width of beam (mm)
E	Modulus of elasticity (MPa)	t_w	Thickness of web (mm)
G	Modulus of rigidity (MPa)	s	Space between stiffeners (mm)
J	Polar moment of inertia (mm^4)	d	Depth of transvers web stiffener (mm)
S	$\int_{y}^{y_{top}} yt(y)dy = \bar{y}'A'(mm^3)$ A' is the top portion of the member's cross-sectional		

I. INTRODUCTION

In many engineering structures, especially in aircraft, overhead roof structure, heavy duty machine like telescopic boom crane and small cranes used in ships, it is important to reduce weight to alleviate structures themselves. One of the commonly used structural components is stiffened beam which may in simply supported or cantilever. Stiffened and unstiffened beam form the basic members for structures and habitation units in offshore structures. Stiffened beam can be longitudinally or/and transversely stiffened. The stiffeners not only carry a portion of load but also subdivide the beam into smaller panels, thus increasing considerably the critical stress at which the beam will buckle. The advantage of reinforcing a beam by stiffeners lies in tremendous increase of strength and stability while minimum increase of weight to the overall structures.

The stability of stiffened beam under various loading has been a topic of interest for many years. Researchers investigated the behaviour of stiffened beam either experimentally or numerically. Due to its complexity and many parameters involved, a complete understanding of all aspects of behaviour is not fully realized. Over the years, several codes and design recommendations for stiffened beam have been developed. However, it is found that no single code provides the most efficient guidance for the design of all structural components subjected to a whole range of loading. Hence, the experimental and analytical study on the strength of the stiffened beam in both longitudinal and transverse directions and subjected to combined action of point load and uniformly distributed load has gained importance.

A recent British Standard has recognized that strength, stiffness and stability are issues concerning safety in these elevated platforms[1]. An initial analytical model of the deflection profile under the extended outreach condition in these vehicles was developed from applying a strain energy method (i.e. to a stepped, tubular, cantilever beam). The testing showed that whilst the analytical model provided for the global deflections with good accuracy, further work would be required to account for the effect of the local deformation behaviour upon the design. Moreover, the self-weight of steel booms added to deflection and load carrying capacity to an extent that the performance of alternative, lighter materials was deemed worthy of investigation. The present proposal is to examine these aspects in more detail especially in context of an optimum design[1].

II. LITERATURE REVIEW

By reviewing different literatures far rectangular cantilever beam with stiffeners

3.1. Standard codes

As per (Research and application of structure, mechanics and computation) I and H sections are more economical under bending about the major axis (Imax larger than for hollow sections). Lateral stability is not critical for rectangular hollow sections with b/h >0.25. It is apparent that hollow sections are especially favourable compared to other sections if bending about both axes is present. The cross section classification is given in limits for the diameter or width to thickness ratio, i.e. d/t, b/t or h/t. The limits are based on experiments and given as:

$$\frac{h}{t} = c.\sqrt{\frac{235}{f_y}} \tag{1}$$

for RHS with fy in N/mm2 and c depending on the section class, the cross section and the loading. The elastic shear stress can be determined with simple mechanics by $\tau = \frac{V_{sd}S}{2It(y)}$ and, Guidance given by codes as US code AISC, EUROCODE EC3, Australian Code AS4100, UK BS5950, Hongkong code for structural steel for designing beams against lateral buckling is limited, extremely variable, and mainly based on the behaviour of doubly symmetric I-beam, which may be overly conservative for other beam such as rectangular hollow section[5]. Design code has little or no guidance for cantilever especially on effect of load height and moment distribution. They developed a method for efficient design for cantilever beam which is consistent with design method for simply supported beam. As per him Eurocode 3 and AS4100 have nearly identical results[5][6].

According to N. S. Trahair [5] elastic buckling for cantilever with end load is as per

$$\frac{QL^2}{\sqrt{EI_yGJ}} = 11\left\{1+\frac{1.2\varepsilon}{\sqrt{1+(1.2\varepsilon)^2}}\right\} + 4(K-2)\left\{1+\frac{1.2(\varepsilon-0.1)}{\sqrt{1+1.2(\varepsilon-0.1)^2}}\right\} \tag{3}$$

$$\text{In which } \varepsilon = \frac{y_Q}{L}\sqrt{\frac{EI_y}{GJ}} = \frac{2y_Q}{d_1}\frac{K}{\pi} \tag{4}$$

For cantilevers with distributed loads

$$\frac{qL^3}{2\sqrt{EI_yGJ}} = 27\left\{1+\frac{1.4(\varepsilon-0.1)}{\sqrt{1+[1.2(\varepsilon-0.1)]^2}}\right\} + 10(K-2)\left\{1+\frac{1.3(\varepsilon-0.1)}{\sqrt{1+[1.3(\varepsilon-0.1)^2]}}\right\} \tag{5}$$

The stability of simply supported rectangular plates under patch compression using Ritz's energy method was studied by Liu and Pavlovic´ (2007)[7]. Both single and double Fourier series were used as deflection series to compute the values for buckling coefficients. But no theoretical solutions exist for more complicated cases such as stiffened plates. Therefore, numerical solutions are often preferred to analyse such complicated responses. Sheikh et al. (2002)[7] investigated stability of stiffened steel plates under uniaxial compression and bending using finite element method. Brubak et al. (2007) [7] presented an approximate semi analytical computational model for plates with arbitrarily oriented stiffeners and subjected to in-plane loading.

3.2. Various stresses applied on beam

Beams are subjected to loads with resultants acting in their plane of symmetry and transverse to their longitudinal axis. Thus, beams carry the loads basically through bending. In the design of beams, the following considerations are necessary:

1. Bending stresses
2. Shearing stresses
3. Local buckling
4. Lateral torsional buckling
5. Web crippling
6. Deflection

Initial selection of the beam is usually made on the basis of the maximum bending stresses. The other design requirements are checked subsequently.

The load carrying capacity of transverse stiffeners, when provided at the locations of the applied loads or reactions, could be determined on the basis of column formulae that included an adjacent portion of the web as a part of the stiffener column. The determination of this effective portion of the web was very complicated for analytical analysis because it would involve the web crippling strength of a combination of beam web and stiffener. The web crippling capacity of the joist is influenced by the presence of the bearing stiffener and the connection of the stiffener to the joist web, Steven [4] The strength of transverse stiffeners alone provide a very conservative result in predicting the load carrying capacity of beam webs loaded at the locations of the transverse stiffeners. Due to the complexity of the problem, the finite element method was adopted as a numerical analysis procedure. Using the finite element method, buckling of overhanging monorails under different load and boundary conditions has been studied [15]. Mitchell present the cantilever beam which is twisted 90° in lateral axis, subjected to bending moment and the shear stress which determine by discretize the span in three parts horizontal, twisted and vertical orientation of beam. To analyze twisted beam they need to calculate moment of inertia for particular part [20]. Results of an analysis the behaviour of straight rectangular box girders to failure when the loads are applied either through diaphragms or from the web flange junction [23]. In this paper effort has been made to design and optimize such footbridge for minimize the total deformation of the structural member by optimizing the cross sections, material properties and weight after the optimization rectangular hollow beam of aluminum alloy was considered for the structural member of the portable footbridge after optimization[27]. According to Bernoulli's theory the lateral dimensions of the beam are less than one-tenth of its length, and then the effects of shear deformation and rotary inertia are neglected for the beams vibrating at low frequency.

Ratio $f = \dfrac{u_3^T(L)}{u_3^B(L)} = 1 + \dfrac{3}{5}(\dfrac{t}{L})^2$ For slender beams (L/t > 20) both theories give the same result[31]. This paper focuses on developing design rules for predicting the nominal crippling strength of CFRP strengthened sharp–corner aluminum tubular sections: rectangular hollow section (RHS) and square hollow section (SHS), under end bearing load[28] as per the AS4100 code[34].

3.3. Various approaches for solving problem

The following methods are producing theoretical model which used to calculate the stresses and its behaviour on element.

1) Classical beam theory
2) Potential Energy model approach
3) Mohr's moment area method for deformation
4) Rayleigh-Ritz method
5) large deflection plate theory
6) double Fourier series approximation
7) Total Lagrangian coordinate system
8) neural network (NN) and genetic expression programming(GEP)
9) power series method
10) Sequential Quadratic Programming algorithm for Optimization

Out of above theories classical beam theory is used to calculate vertical displacement, this theory does not applicable for stress and strain. For that indirect method is used to calculate stresses and strain[20]. Energy model approach is applied to analyse equally spaced, concentric stiffeners with identical cross-sectional properties[13]. According to Jeevan George the Mohr's moment area method is simple and accurate and compare with potential energy approach like Castiglione's theorem and virtual works as well as Macaulay's theorem having identical results for the calculation of deformation and its slope. Advantage of Mohr's method is also applied for varying cross section beam[1]. Same as large deflection plate theory is basically nonlinear differential equation developed by von Karman (Ugural 1981) [3]. The stress and deflection of the strip of the plate is generally calculated by considering large deflection plate theory to include the bending stress and diaphragm stress, Thanga presented a discrete element approach to compute the elastic buckling of stiffened plates subjected to uniform longitudinal compression. These formulations were connected to simply supported plates with the equally spaced and equally sized stiffeners using double Fourier series approximation. The main advantage of this approach is the size of the eigenvalue problem is not depending of the number of ribs compared with other numerical methods[3]. Analyse the initial buckling of longitudinal and transverse concentric plates with the simply supported boundaries under certain assumption with Rayleigh-Ritz method. They ignored the torsional stiffness of the stiffeners due to the complications arrived in interpreting the results[13]. Total Lagrangian coordinate system using von Karman's large deflection plate theory. The governing equations are nonlinear which are further solved by iterative technique using Newton Raphson method. The mathematical formulation is further based on the following assumptions:

1. Plate and stiffener materials are isotropic, homogeneous, and linearly elastic.
2. Thicknesses of the plate and stiffener are uniform.
3. The thickness of the plate is sufficiently small compared to the lateral dimensions, so that he effect of shear deformation and rotary inertia may be neglected[14].

The incremental tangent stiffness method and the incremental theory of plasticity were selected for the solution of the nonlinear problem[23]. Thin walled beam theory is very useful for curved beam structure[24]soft-computing based study aimed to estimate the available rotation capacity of cold- formed rectangular and square hollow section (RHS-SHS) steel beams is described and novel mathematical models based on neural network (NN) and genetic expression programming (GEP) are proposed[26]. K.E. Bisshoppe and D.C. Drucker[35], used the power series method to obtain a solution for a uniform cantilever beam, which was loaded (1) by a concentrated load at its free end, and (2) by a combined load consisting of a uniformly distributed load in combination with a concentrated load at the free end of the member. J.H. Lau also investigated the flexible uniform cantilever beam loaded with the combined loading, consisting of a uniformly distributed load along its span and a concentrated load at its free end, by using the power series method. He proved that superposition does not apply to large deflection theory, and he plotted some load–deflection curves for engineering applications. The purpose of the present paper is to present a small deflection theory for buckling of an orthotropic cylinder stiffened by both stringers and rings[36]. Deflection of elastic beam under uniformly distributed load along its length (its own weight) and an external vertical concentrated load at the free end is experimentally and numerically analysed[38].

3.4. Stiffened beam or plate

As per literature survey allocate stiffener along the web or flange to enhancing the strength and reduce the deformation. Thanga present study about large industrial duct in which the plates along with stiffeners acts to resist the pressure loads and to carry other loads to the supports by transverse stiffeners[3]. According to Steven Fox [4] In C section beam transverse Bearing stiffeners are normally added to avoid the capacity reductions associated with this type of failure. Stiffeners will be required to meet the mechanical resonant frequency requirement and due to stiffener deformation is reduce.[8] where the different types of stiffeners are there according to its application like bearing stiffener which bears load, Intermediate stiffener which support the structure, transverse stiffener and ring stiffener increase the buckling strength and longitudinal stiffener are used to reduce bending moment and lateral buckling. Bearing stiffeners are usually much thicker than intermediate or connection stiffeners because they pass all of the vertical loads from the deck and superstructure to the bearing devices. Bearing stiffeners also act as connection plates for end diaphragms or cross frames[9]. By using Finite Element Analysis method, It is found that the best design is by using stiffeners on both of the two sides of square plate and it gives better results[11]. Loghman's research expresses the non-linear analysis of the impacts of the cross sections(R, T, I) and number of stiffeners (0-5) in improving the buckling and ultra-buckling behaviour of plates that have been stiffened with longitude stiffeners under the impact of pressure axial load[12]. Effective length factors for doubly symmetric I-section cantilevers. Cantilevers were analyses under different loading and boundary conditions using the finite element method.[16] Zhang et al presented the influences of initial deformation on longitudinal strength were regarded as the reduction of section modulus of ship hull. Both longitudinally and transversely stiffened plates were investigated. The use of stiffeners allows designers to reduce the section size for a fixed load and span, increase the spacing of fly bracing in portal frame rafters and columns, or increase the span for a fixed load without using a larger section. The significant cost benefits obtained suggest that the use of stiffeners may make the Hollow Flange Beam more attractive to designers, boosting the product's potential market share[21].

An investigation using finite element analyses and large scale experiments was carried out into the use of transverse web plate stiffeners to improve the lateral buckling capacity of HFBs. that web stiffeners and batten plates increase the lateral buckling strength of beams due to the local increment in the torsional and bending stiffness's at the stiffened cross-section. Past research has demonstrated the use of different type of stiffeners, Szewczak [22] as per the paper they performed test on 5 different types of web stiffener arrangement on HFB. Based on the results from the analysis and some preliminary experiments, 5 mm transverse web plate stiffeners welded to the flanges on both sides of the web are recommended[21]. Optimize the structure by reducing the thickness of the structure of hydraulic vertical broaching machine, if needed stiffeners provided in order to maintain the strength and rigidity of the machine structure[29]. In this paper stiffness of castellated beams decrease as the depth of opening increases. For that increment of shear strength shear stiffeners are introduced along the web opening for further enhancement of strength stiffener are provided vertically along with diagonal stiffeners.

Thickness of unstiffened web bounded on both longitudinal sides by flanges: $= \frac{d}{180}\sqrt{\frac{f_y}{250}}$ (6)

Thickness of stiffened web bounded on both longitudinal sides by flanges:

$$= \frac{d}{200}\sqrt{\frac{f_y}{250}} \quad For\ 1.0 \le s/d \le 3.0$$
$$= \frac{s}{200}\sqrt{\frac{f_y}{250}} \quad For\ 0.74 < s/d \le 1.0 \qquad (7)$$
$$= \frac{d}{270}\sqrt{\frac{f_y}{250}} \quad For\ s/d \le 0.74$$

Essentially the web thickness can be reduced with increasing use of transverse and/or longitudinal stiffeners. Details of arrangement of load bearing stiffeners, side reinforcing plates, webs designed plastically and web openings are given in AS 4100 Clauses 5.10.2, 5.10.3, 5.10.6 and 5.10.7, respectively.

The web failure mode and therefore the web shear capacity will depend on web slenderness

$$= \frac{d}{t_w}\sqrt{\frac{f_y}{250}} \qquad (8)$$

Where t_w and f_y are the web thickness and yield stress, respectively and *d* is the clear transverse dimension of a web panel.

Stiffener spacing with s/d in the range of 0.5 to 2.0 is considered the most efficient. The use of stiffeners will increase the design capacity and allow the designer to use a thinner web. However, the cost of stiffened beams will be higher and this should be kept in mind. Design criteria and its boundary condition for load bearing stiffeners (yield and buckling capacities), Intermediate transverse web stiffeners, and longitudinal web stiffeners are explained in Clauses 5.14, 5.15 and 5.16 of AS 4100, respectively.

The designer has the choice of using a thicker web or intermediate transverse stiffeners to increase the web shear strength, particularly for deep plate girders. In some cases, it will be cost-effective to just increase the web thickness instead of costly installation of stiffeners. However, for deeper girders, $(d/t > 100)$ the use of stiffeners can increase the shear strength considerably and hence the use of stiffeners at appropriate spacing is very beneficial. The choice of stiffener spacing is also important as the shear strength can increase rapidly with smaller spacing changes.

According to Timoshenko beam theory shear coefficient k for various shapes [42]

$$C_4 = \int_A \left[\nu\left(f_1 y^2 - f_1 z^2 + 2 f_2 yz \right) + 2(1+\nu)(f_1^2 + f_2^2) \right] dA \quad (9)$$

$$f_1 = -\frac{1}{2(1+v)}\left(\frac{\partial \chi}{\partial y} + \frac{vy^2}{2} + \frac{(2-v)z^2}{2}\right)$$
$$f_2 = -\frac{1}{2(1+v)}\left(\frac{\partial \chi}{\partial y} + (2+v)yz\right) \tag{10}$$

$$k = \frac{2(1-\nu)}{\left[\frac{A}{I_z^2}C_4 + \nu\left(1+\frac{I_y}{I_z}\right)\right]} \tag{11}$$

For Rectangular cross section

$$C_4 = \frac{4}{45}a^3b(-12a^2 - 15\nu a^2 + 5\nu b^2) + \sum_{n=1}^{\infty}\frac{16\nu^2 b^5\left(n\pi a - b\tanh\left(\frac{n\pi a}{b}\right)\right)}{n\pi^2(1+\nu)} \tag{12}$$

$$k = -\frac{2(1+\nu)}{\left[\frac{9}{4a^5 b}C_4 + \nu(1+\frac{b^2}{a^2})\right]} \tag{13}$$

Where the depth of beam(y direction) 2a and the width of beam (z direction) 2b

3.5. Effect of numbers of stiffeners and its locations

In previous section importance of stiffeners we have seen, but there is also design parameters are there like numbers of stiffeners and its location which improving the result without any extra investment.

Method of spacing stiffeners is based on large deflection plate theory. A parametric study was conducted on dimensionless parameters identified in order to benefit from membrane action in partially yielding plate for spacing stiffeners. Roark's Formulas for Stress and Strain by Young (1989)[3] provide simplified design tables which are currently used in the industry to establish stiffener spacing and plate thickness. Thanga[3] bearing stiffener is the principal load-carrying member in the assembly, and the stiffener type and size will significantly influence the capacity. Steven[4] the locations of stiffeners are chosen as design variables Sequential Quadratic Programming algorithm is used to optimize the design variables. Results are presented to show the influence of size optimizations and also stiffener locations. In these analyses, skin and stiffeners thicknesses are kept constant and the positions of stiffeners are changed systematically[7]. Finite element method to optimization of the stiffeners location in the 2-D structures (plane stress, bending plates and shells) [9]. Perry-Robertson formula modified by Murray and the design variables considered were the number, the thickness and the height of the stiffeners for a specific plate thickness.

There is little variation of stiffener thickness on strength beam and independent of cross section but was significantly greater for short spans (compare the 2000 and 6000 mm spans) and almost negligible for long spans and the location of stiffener effect[21]. From the thin-walled elastic beam theory and other procedures of analysis by varying thickness, it is known that deflections and stresses are reduced if a rigid diaphragm is provided at the load point. As the thickness is increased from zero, both the web shearing stresses and particularly the maximum deflection reduce rapidly up to certain limit not affected by further increase of thickness. It must be pointed out that diaphragm spacing has little effect on bending of box girders[23].

3.6. Software application

Finite element method is the most powerful and most preferred method in structural analysis domain and has the capability of solving all types of complex geometries, loading and boundary conditions.[1][2][7][10][17][18]

Numerical procedures like

Finite element method/Analysis,
Finite strip method and
Finite difference method [13].

If the stiffeners are identical and equally spaced rather than computation cost becomes excessive since the whole structure needs to be discretized[13]. Spline finite strip method is applied to the large deflection analysis of plates and stiffener[23]. Using the FEM method, there is an immense range of applications of this numerical tool to the stability analysis of thin-walled structures and members, so here only some recent works that explore the generality of the method are cited. The group of the Cornell University, headed by Prof. T. Peköz, make a wide use of the FEM to the analysis of thin walled members and frames (Sarawit, Kim, Bakker and Peköz 2003) from[32]. The report made by arawit and Peköz (2003) presents an exhaustive description of the advances recently added, covering all major aspects of the industrial steel storage racks, from the behaviour of column bases, beam-to-column connections, structural members, to the FEM analysis of entire pallet rack systems, and comparing with design methods that are or will be adopted by current design codes. The group of the University of Timisoara, headed by Prof. D. Dubina, produces also a wide FEM based research work on cold-formed structures: two examples of this are the development of an alternative interactive buckling model, the Erosion of the Critical Bifurcation Load (ECBL) approach (Dubina, Davies, Jiang, and Ungureanu 1996) and the research on plastic buckling analysis in cold-formed construction (Dubina, Goina, Georgescu, Ungureanu, Zaharia 1998) all from [32].

FEA analyses carried out by using ABAQUS and calculate the tensile, compressive and shear stresses and vertical displacement and compare with the theoretical value[19][20]. FEM also done by SAP2000[24] at some where validation of nonlinear FEA simulation (ANSYS) is done by experimental method[25][27][38].

We study about effect of selecting various elements for discretization of component in FEM. They using ANSYS for test and found the deflection is more accurate when 10 node tetrahedral elements is used but for stresses 8 node brick element gives better results[40]. Solid works where used for the modeling as well as simulation[27][29].

Fernando Pedro[32] presents in its literature that the FSM is derived from the FEM and consists on a specialization of the FEM to the analysis of thin walled members from (Schafer 1998), in which the only difference consisting on the longitudinal discretization of the member, The FEM uses a mesh that discretizes the member transversally and longitudinally, while the FSM needs only transversal discretization, using currently either harmonic or spline functions in the longitudinal direction of the member. It was originally developed by Cheung (Cheung 1976, Cheung and Tham 2000) in [32] and was widely used by other authors for understanding and predicting the behaviour of cold-formed steel members and for bridge decks (Cheung, Li and Chidiac 1996) in [32] – a concise overview of the FSM can be found in Graves-Smith (1987). The work of Hancock (1978), a study on the elastic buckling of I-section beams, can be considered as a starting point on the use of the FSM as an analysis tool for the stability behaviour of thin-walled members, and several other works using a similar strategy for other types of cross sections and load conditions followed, many of them from the research group of the University of Sydney. Hancock (1981) in [32] applied the FSM to the stability analysis of I-section columns, comparing the FSM to the alternative analysis and/or design models of that time, and Kwon and Hancock (1991 and 1993) in [32] extended to the elastic post-buckling analysis of thin-walled members under bending and/or compression. Outside Sydney several other research groups also widely explored the FSM [32].

B. Anupriya and K. Jagadeesan focused on the investigation behaviour of shear strength of castellated beam through an extensive FE study (ANYSIS14)[30].

From the researcher's papers, they developed program which calculate deformation, stresses, strain and all relative measurements. Some of them listed below,

1. PANDA2 [33]
2. FRPBEAM [39]
3. HANBA2 [37]
4. MATLAB program

In MATLAB program by use of iteration processes, can optimize the structural weight and production costs for a case of chosen ship type, main perpendiculars, number of decks, deck loads. The output of the program shall be optimum stiffener spacing and plate thickness of the structure in an early design phase as well as steel weight and production costs. A transverse stiffener shall be provided at the location of concentrated loads if patch loading resistance is exceeded[41].

III. CONCLUSION

Critical review is carried out on design and analysis of beam structure especially cantilever and hollow section. Many researcher have worked on various methodology used for solving concern loading condition and problem statement. The modern and conventional methods are adopted by some researcher and develop their own program and theories.

But in the regarded of stiffened beam especially cantilever beam which is rectangular and hollow the limited work done and limited guidelines available. Study regarding Stiffened beam is open source for the researcher. As well stiffened structure is complex due to variation in stress flow and non-uniform cross section for performing theoretical work so FEM is the best way to analyses. So, for new researchers this paper is helpful and gives new domain to carry out research in design of beam and analysis of rectangular hollow cantilever beam with applying stiffeners.

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