

ABSTRACT

Now-a-days the use of castellated beam has been admired due to its beneficial functions like light in weight, easy to erect, economical and stronger. The castellated beam is manufactured from its parent solid I beam by cutting it in zigzag pattern and again joining it by welding, so that the depth of the beam increases. Hence, due to increase in depth of beam load carrying capacity of the parent I section is increased with same quantity of material. The increase in depth of castellated beam leads to web post buckling and lateral torsional buckling failure when these beams are subjected to loading. There are many other modes of failure like lateral torsional buckling, formation of flexure mechanism and formation of vierendeel mechanism, rupture of the welded joint in a web post and shear buckling of a web post which needs to be taken care of. Study shows that use of stiffeners in the web portion of beam effectively helps in minimizing these failures. Therefore, a detailed study in respect of number of stiffeners, size of stiffener and there locations in the web portion of castellated beam needs to be carried out. Hence, in the present work an attempt has been made to review existing literature, concerned with the various positions of stiffeners in the Castellated Beams with Sinusoidal openings.

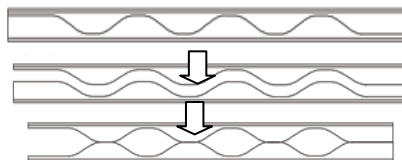
KEYWORDS: Sinusoidal Openings, Vierendeel mechanism.

INTRODUCTION

The provision of beams with web openings has become an acceptable engineering practice, and eliminates the probability of a service engineer cutting holes subsequently in inappropriate locations. Beams with web openings can be competitive in such cases, even though other alternatives to solid web beams such as stub girders, trusses etc. are available. This form of construction maintains a smaller construction depth with placement of services within the girder depth, at the most appropriate locations. The introduction of an opening in the web of the beam alters the stress distribution within the member and also influences its collapse behavior. Generally, the castellated beams are with hexagonal or square or circular shaped openings. As a modification, in castellated beam with hexagonal opening, the corners of opening are made round so as to offer smooth stress transfer area to avoid stress concentration. The beams with such curved shaped openings are known as castellated beam with sinusoidal openings.

CASTELLATION PROCESS

Castellated beams are such structural members, which are made by flame cutting a rolled beam along its centerline and then rejoining the two halves by welding so that the overall beam depth is increased by 50% for improved structural performance against bending.

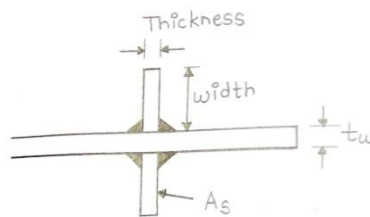


STIFFENERS

Stiffeners are those structural components which are used to strengthen shear and moment resistance of steel plates along the longitudinal, transverse or along the edge of opening. It is common practice to use stiffeners to strengthen the moment and shear resistance of steel plates and connections along the longitudinal or transverse direction when designing lightweight structures. It is observed that there is no regulated knowledge of how a

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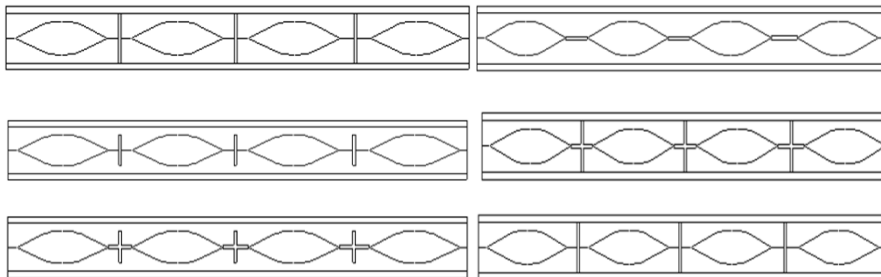
beam with Sinusoidalweb openings would behave if a transverse stiffener or stiffeners along its edges was placed in the beams. Primary issues that have arisen with the use of perforated beams relate to the shape of the openings should have, how large the openings should be, the proximity of the openings to each other and provision of lateral supports. Significant experimental and theoretical research has been made in the last decade with the aim to maximize the web opening area and minimize the self-weight of the beam. To overcome the buckling failures in sinusoidal beams under heavy loading we have to provide stiffeners in opening area or web post area with proper dimensions. The strength enhancement is important in case where large load concentration is observed in the beam. The behavior and failure modes are necessary to be checked using stiffeners in the appropriate place so that the efficiency of the beam is increased in worst condition of stress concentration and web buckling. In present case the effect of various positions of stiffeners in the castellated beam are studied. Till now there is no proper design for the stiffeners of castellated beam. There are few guidelines provided in Euro Code 3. In which only the rough knowledge of spacing and the minimum area for the stiffener that should be provided is specified. It has also suggested that the stiffeners must be double sided and so placed that it should be symmetric about centerline of the web.



A_s =Area of Stiffener.
 t_w =Thickness of Web.

The future scope defined by few researchers in papers give a rough idea of good performance of the castellated beam using stiffeners. Also this performance will enhance strength and torsional behavior when designed with stiffeners.

In present work stiffeners are provided at various places in Sinusoidal castellated beam as shown in following figures:



With reference of paper, Titled Optimization Of Opening Size For Castellated Beam With Sinusoidal Openings by P. D. Kumbharand A. M. Jamadar (Reference 10), the optimum parameters of Castellated Beam with Sinusoidal openings are selected for the analysis are as follows:

D (mm)	Do(mm)	D/Do	S/Do	S (mm)	e (mm)
155	110	1.41	1.4	154	32.12

From the result of this analysis it is observed that the beam with depth of opening 0.55 times its overall depth behaves satisfactorily in respect of load carrying capacity (32.2kN). In the other words beam with D/Do ratio of 1.41 and S/Do ratio of 1.4 gives more satisfying results than the others.

This Optimum Sizes of Sinusoidal opening with different positions of stiffeners are studied and analyzed using Ansys Software Analysis.

CONCLUSION

Analysis and design of castellated beams need to be carried out by using stiffeners in transverse direction and also along the edge of openings in order to minimize web post buckling. In case of transverse stiffener, each stiffener acts as a single short column and hence integrates the load carrying capacity. It also helps in compensating faults of welded joints. The volume consumed by transverse stiffener is less than the stiffener along the edge of opening. If diagonal stiffeners are provided along the shear zone of web openings, deflection can further be reduced. Optimization of castellated beams with stiffeners by varying the parameters namely, size and positions in web portion is necessary.

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