International Multidisciplinary Research Journal

Indian Streams Research Journal

Executive Editor Ashok Yakkaldevi Editor-in-Chief H.N.Jagtap

Welcome to ISRJ

RNI MAHMUL/2011/38595

ISSN No.2230-7850

Indian Streams Research Journal is a multidisciplinary research journal, published monthly in English, Hindi & Marathi Language. All research papers submitted to the journal will be double - blind peer reviewed referred by members of the editorial board. Readers will include investigator in universities, research institutes government and industry with research interest in the general subjects.

International Advisory Board

Flávio de São Pedro Filho Federal University of Rondonia, Brazil

Kamani Perera Regional Center For Strategic Studies, Sri Lanka

Janaki Sinnasamy Librarian, University of Malaya

Romona Mihaila Spiru Haret University, Romania

Delia Serbescu Spiru Haret University, Bucharest, Romania

Anurag Misra DBS College, Kanpur

Titus PopPhD, Partium Christian University, Oradea, Romania

Mohammad Hailat Dept. of Mathematical Sciences, University of South Carolina Aiken

Abdullah Sabbagh Engineering Studies, Sydney

Ecaterina Patrascu Spiru Haret University, Bucharest

Loredana Bosca Spiru Haret University, Romania

Fabricio Moraes de Almeida Federal University of Rondonia, Brazil

George - Calin SERITAN Faculty of Philosophy and Socio-Political Sciences Al. I. Cuza University, Iasi

Hasan Baktir English Language and Literature Department, Kayseri

Ghayoor Abbas Chotana Dept of Chemistry, Lahore University of Management Sciences[PK]

Anna Maria Constantinovici AL. I. Cuza University, Romania

Ilie Pintea. Spiru Haret University, Romania

Xiaohua Yang PhD. USA

.....More

Editorial Board

Pratap Vyamktrao Naikwade Iresh Swami ASP College Devrukh, Ratnagiri, MS India Ex - VC. Solapur University, Solapur

R. R. Patil Head Geology Department Solapur University, Solapur

Rama Bhosale Prin. and Jt. Director Higher Education, Panvel

Salve R. N. Department of Sociology, Shivaji University,Kolhapur

Govind P. Shinde Bharati Vidvapeeth School of Distance Education Center, Navi Mumbai

Chakane Sanjay Dnyaneshwar Arts, Science & Commerce College, Indapur, Pune

Awadhesh Kumar Shirotriya Secretary, Play India Play, Meerut(U.P.) N.S. Dhaygude Ex. Prin. Dayanand College, Solapur

Narendra Kadu Jt. Director Higher Education, Pune

K. M. Bhandarkar Praful Patel College of Education, Gondia

Sonal Singh Vikram University, Ujjain

G. P. Patankar

Maj. S. Bakhtiar Choudhary Director, Hyderabad AP India.

S.Parvathi Devi Ph.D.-University of Allahabad

Sonal Singh, Vikram University, Ujjain

Rajendra Shendge Director, B.C.U.D. Solapur University, Solapur

R. R. Yalikar Director Managment Institute, Solapur

Umesh Rajderkar Head Humanities & Social Science YCMOU,Nashik

S. R. Pandya Head Education Dept. Mumbai University, Mumbai

Alka Darshan Shrivastava S. D. M. Degree College, Honavar, Karnataka Shaskiya Snatkottar Mahavidyalaya, Dhar

> Rahul Shriram Sudke Devi Ahilya Vishwavidyalaya, Indore

S.KANNAN Annamalai University, TN

Satish Kumar Kalhotra Maulana Azad National Urdu University

Address:-Ashok Yakkaldevi 258/34, Raviwar Peth, Solapur - 413 005 Maharashtra, India Cell: 9595 359 435, Ph No: 02172372010 Email: ayisrj@yahoo.in Website: www.isrj.org

Indian Streams Research Journal ISSN 2230-7850 Impact Factor : 3.1560(UIF) Volume-5 | Issue-2 | March-2015 Available online at www.isrj.org





DYNAMIC ANALYSIS OF A MONORAIL BEAM FOR AN OVERHEAD CRANE

Naba Raj Gairhe¹, K.V. Ramana² and D.V.A Ramasastry³

¹²³Department of Mechanical EngineeringKLEF (KL University), Vaddeswaram AP, India

Abstract:-A monorail beam is subjected to dynamic load. The design engineer is more concerned with its vibration behavior under undamped, no load condition to avoid resonance, which may lead to a catastrophic failure. One of the major failure reasons is formation of crack and its propagation, over a time. Emphasis is to be given to the investigation of the natural frequency and corresponding natural modes of the beam material which will furnish useful data, for prevention of crack. This paper addresses estimation of vibration displacement and natural frequencies of a standard I- Section, selecting 3 commercial grade steels and subsequently suggesting the appropriate material for a monorail beam.

Keywords: Monorail Beam, Natural frequency, Resonance, Crack

INTRODUCTION:

Earlier works on monorail beam have focused mainly on lateral distortion, buckling and crack analysis [1, 2, 3]. Trahir [4] developed a method for designing a wide range of single span, double span, cantilever and overhanging monorails for their flexural torsional buckling analysis. Jassiam Z.A et al. [5] have reviewed different types of vibrational analysis for damage occurrence of a cantilever beam. Lee C.H. et al. [6] have compared the analytical results with the field test data and observed the possibility of resonance when a car moving on a steel bridge. Ping Lin H. [7] has analyzed the crack depth and crack position with respect to moving load on a steel structure. Yang T. H. [8] have done analysis on functionally graded beams, where the material property changes layer by layer and found that dynamic deflection is changing due to presence of an edge crack. Jena P.K. et al. [9] have analyzed the effect of crack location and crack intensity on the natural frequency and natural modes of a cantilever beam for different loading conditions. Sadettin [10] has analysed a cracked beam for its dynamic behavior.

The literature clearly reflects that the earlier works have confined to either distortional analysis or dynamic analysis of cantilever beams with an edge crack. In this paper an attempt has been made to extract first few eigenvalues and corresponding eigenvectors of a monorail beam of symmetrical I- section for an overhead crane to eliminate basically a crack formation. The work is further extended to optimize the material for the same geometry of the beam section

Modeling

Monorail crane is the principle transporter for all plant and equipment. Layout of a structure is shown in Fig.1. The dimensions and properties as per the BS4-1:1993 aregiven in Table 1. Material optimization has been done selecting Mild Steel, Stainless Steel and low Alloy Steel. Material properties are furnished in Table. 2. The section has been modeled using Plane 42 and extruded with Solid 45, for the accurate analysis, using ANSYS Version 14. These elements offer more accuracy when modeling structure with straight boundaries. Fig.3 shows the elements. The meshing of the structure is shown in Fig.4.

Naba Raj Gairhel, K.V. Ramana 2 and D.V.A Ramasastry 3, "DYNAMIC ANALYSIS OF A MONORAIL BEAM FOR AN OVERHEAD CRANE "Indian Streams Research Journal | Volume 5 | Issue 1 | Feb 2015 | Online & Print [•] Dynamic Analysis Of A Monorail Beam For An Overhead Crane







Fig.1 Standard I section

Table 1Dimension of I section beam

D (cm)	259.6
B (cm)	147.3
T (cm)	12.7
t (cm)	7.2
MOI_{xx} (cm ⁴)	6544
$MOI_{yy}(cm^4)$	677
C/S area (cm ²)	54.8



Indian Streams Research Journal | Volume 5 | Issue 2 | March 2015

Fig. 1 Element Shapes



Fig. 4 Meshed Monorail

Table 1 Material properties

Material	Young Modulus	Density	Poissons ratio	
	(N/mm^2)	(Kg/mm ³)		
Mild Steel	2.10E+05	7.90E-06	0.3	
Stainless Steel	2.00E+05	8.00E-06	0.3	
Low Alloy Steel	2.03E+05	7.80E-06	0.3	

Analysis

Modal analysis has been done for the first 10 modes to extract natural frequencies and corresponding natural modes. The investigation has been carried out selecting 1st, 5th and 10th modes.

Results and Discussion

The computed values, namely natural frequencies and max deflections are given in Table.3, for the selected modes. The deformed shapes of the beam are shown in Fig. 5. Mode shape plots are illustrated in Fig. 6. Deflection of the beams along X, Y and Z directions are plotted with respect to span are shown in Fig. 7.

It is evident from Table.3 and Fig. 6, that stainless steel exhibiting low natural frequencies and as well as deflection at all the 3 modes compared to mild steed and Low alloy steel. The reason can be attributed to material property that is density. For all the 3 materials, deflection is observed to be maximum along X- axis that is, in the transverse direction. It is also observed from Fig.6that in 5th and 10th mode the beam is displacing along the longitudinal axis.

Table	3	Freq	uencv	and	Disp	lacement
	-					

	1 st Mode		5 th Mode		10 th Node	
Material	Freq(hz)	DMX (mm)	Freq (hz)	DMX (mm)	Freq (hz)	DMX (mm)
Mild Steel	1.431	0.249083	47.401	0.236497	151.7	0.208909
Stainless Steel	1.387	0.247522	45.969	0.235014	147.116	0.207599
Low Alloy Steel	1.415	0.250674	46.902	0.238008	150.103	0.210243



Fig. 6(b) Stainless Steel



Fig.7(c)

Fig.7 Deflection of beams

Indian Streams Research Journal | Volume 5 | Issue 2 | March 2015

CONCLUSION

The dynamic analysis of industrial monorails is gaining importance. Analysis has been done on an overhead crane monorail. The theoretical investigation shows the mode shapes and natural frequencies under undamped and load free condition for 1st, 5th, and 10th modes. The analysis reflects that stainless steel is the optimum material owing to its dynamic response characteristics.

REFERENCES

1.N.S. Trahair "Distortional buckling of overhanging monorail beams" Engineering Structures 32(2008) 3213-3218.

2.O. Kerem Murat and C. Topkaya "Lateral buckling of overhanging crane trolley monorails" Engineering structure 28(2006) 1162-1172

3.Stifrin E.I and Ruotolo R "Natural frequencies of a beam with an arbitrary no of cracks" Journal of Sound and vibration; 1999; 223(3): 409-23

4.N.S. Trahair "Lateral Buckling of monorail beams" Engineering Structures 32(2010) 982-987

5.Z.A. Jassim et al."A review on the vibration Analusis for a damage occurance of a cantilever beam" Engineering Failure Analysis 31(2013)442-461.www.elsevier.com/locate/engfailand.

6.C.H. Lee et al "Dynamic response of a monorail steel bridge under a moving train "Journal of sound vibration 294(2006) 562-579

7.Hai-Ping Lim "Force response of cracked cantilever beams subjected to a concentrated moving load" Internal Journal of mechanical sciences 48(2006) 1456-1463

8.T. Yan and Y Yang "Foced Vibration of Edge- cracked functionally graded beams due to a transverse moving load. "Procedia Engineering 14(2011)3293-3300

9.P.K. Jena et al "Effect of damage parameters on vibration signatures of a cantilever beam" Procedia Engineerings 38(2012)3318-3330

10.Sadettin Orhan "Analysis of force and forced vibration of a cracked cantilever beam" NDT & E International 40(2007)443-50.



Naba Raj Gairhe

Department of Mechanical EngineeringKLEF (KL University), Vaddeswaram AP, India

Publish Research Article International Level Multidisciplinary Research Journal For All Subjects

Dear Sir/Mam,

We invite unpublished Research Paper,Summary of Research Project,Theses,Books and Book Review for publication,you will be pleased to know that our journals are

Associated and Indexed, India

- International Scientific Journal Consortium
- ★ OPEN J-GATE

Associated and Indexed, USA

- Google Scholar
- EBSCO
- DOAJ
- Index Copernicus
- Publication Index
- Academic Journal Database
- Contemporary Research Index
- Academic Paper Databse
- Digital Journals Database
- Current Index to Scholarly Journals
- Elite Scientific Journal Archive
- Directory Of Academic Resources
- Scholar Journal Index
- Recent Science Index
- Scientific Resources Database
- Directory Of Research Journal Indexing

Indian Streams Research Journal 258/34 Raviwar Peth Solapur-413005,Maharashtra Contact-9595359435 E-Mail-ayisrj@yahoo.in/ayisrj2011@gmail.com Website : www.isrj.org