

**DESIGN BENDING MOMENT IN CONCRETE BOX
STRUCTURES**
**A COMPARATIVE ANALYSIS BETWEEN SHELL AND SOLID ELEMENT
MODELS**

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Degree of Master of Engineering in Structural Engineering Designs

Department of Civil Engineering

University of Moratuwa
Sri Lanka

March 2016

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of Engineering in Structural Engineering Designs

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DECLARATION

I declare that this is my own work and this dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidate has carried out research for the Masters Dissertation under my supervision.

Dr. K.Baskaran

Date: 29th of March 2016

ABSTRACT

Concrete box structures are mainly used in railway and highway projects as culverts or frame bridges. Structural engineers prefer to do finite element method (FEM) analysis using shell or frame element models to obtain bending moment diagram (BMD) for design. Structures are modelled center to center supports in shell element models. BMD of general shell element models are continuous throughout the center to center spans and maximum support moment occurs at center of supports. ACI design practice recommends selecting bending moment at face of the support as design value, but BS design practice is different and obtains bending moment value at center of the support for designs. Some literature suggests tedious bending moment correction according to the stiffness of the members of the joint.

In general shell element modeling, inside rigidity of supports is not considered. However general shell element models can be modified at support region to represent the rigidity of the support area.

Previously tested concrete box structure was modelled using general shell, modified shell and solid elements. Results of solid element model are much closer to experimental results at supports and spans than other models. This result validated that solid element of box culvert can be used as a base for comparison of general and modified shell models.

In this study, BMD of general shell, modified shell and solid element models relevant to concrete box structures were compared to load combinations relevant to Sri Lankan Railways. The results show that BMD of solid and modified shell elements are much more similar than the general shell models. Support design bending moment can be obtained from modified shell models with reliability without confusion of center or face value to select for the design as for the general shell element models.



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Keywords: Bending moment diagram, Modified shell model, Solid elements, concrete box culverts, maximum support moment.

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LIST OF ABBREVIATIONS

Abbreviation	Description
ACI	American concrete institute
BMD	Bending moment diagram
BME	Bending moment envelop
BS	British Standard
FEM	Finite element method
RC	Reinforced Concrete
SLS	Service limit state
ULS	Ultimate limit state



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