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Wei-Wen Yu Center for Cold-Formed Steel Structures

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Abstracts of Conference Papers for 18th International Specialty Conference on Cold-Formed Steel Structures 2006

On October 26th and 27th, 2006 the 18th International Specialty Conference on Cold-Formed Steel Structures will be held in Orlando, Florida. For further information regarding the conference contact the Wei-Wen Yu Center for Cold-Formed Steel Structures (Telephone: 573-341-4471, Fax: 573-341-4476, e-mail: ccfss@umr.edu). This Technical Bulletin provides a brief summary of the papers that are scheduled to be presented and will appear in the conference proceedings.

"The Strength of Stiffened CFS Floor Joist Assemblies with Offset Loading," S. Fox
Described in this paper are the results of an experimental investigation into the behavior of cold-formed steel floor assemblies subjected to variations in the alignment of the load bearing wall stud with the supporting floor joist. The work concluded that a ¾ inch offset can cause a significant reduction in the strength of the assembly for systems that are designed as in-line framing.

"Parameter Study for First-Generation Sheeting Failure using a Theoretical and FE Model," H. Hofmeyer, M. Rosmanit and M.C.M. Bakker
First generation sheeting is sheeting without longitudinal and transverse stiffeners. In this paper a FE model is used to predict failure for a systematic variation of sheeting variables and the failure loads are used to check a theoretical model. For varying web width, angle between web and flange, corner radius, yield strength, sheet thickness and span length the theoretical model compared well to the finite element model.

"A Design Guide for Bracing Cold-Formed Steel Structures," T. Sputo and J. Turner
This paper provides an overview of a design guide Bracing Cold-Formed Steel Structures: A Design Guide. The guide introduces the engineer to the current state-of-the-art for bracing cold-formed steel members and systems, provides design examples, and provides literature references to enable further study of the subject.

"Finite Element Modeling of Cold-Formed Steel Beams: Validation and Application," C. Yu and B. Schafer
A non-linear finite element model is presented that simulates two series of flexural tests performed by the authors. The test specimens were industry standard C- and Z-sections. The first test series focused on local buckling failures and the second series of tests addressed distortional buckling failures. An empirical equation, appropriate for use in design, to predict the increase in the elastic distortional buckling moment gradient is provided.

"The Strength of CFS Floor Assemblies with Clip Angle Bearing Stiffeners," S. Fox
Described in this paper are the results of an experimental investigation into the strength of cold-formed steel floor joist assemblies utilizing clip angles as bearing stiffeners. The experimental phase of the investigation consisted of 120 end-two-flange loading tests. A design approach to calculate the design strength of a clip angle bearing stiffener is presented.

"Local and Distortional Buckling of Cold-Formed Steel Studs Using Direct Strength," J. Tovar and T. Sputo
A study to develop methods of analyzing perforated, axially loaded, cold-formed steel wall studs using the Direct Strength Method is reported in this paper. The capacities predicted using the Direct Strength Method for the limit states of distortional buckling and local buckling were compared to capacities calculated by using the effective width equations of the AISI Specification. The validity of the results is discussed and recommendations are made when using the

Direct Strength Method for wall studs with holes.

"Longwave Buckling of Cold-Formed Steel Studs Using Direct Strength," T. Sputo and J. Tovar
A study to develop methods of analyzing perforated, axially loaded, cold-formed steel wall studs using the Direct Strength Method for determining the elastic buckling stress is reported in this paper. It was confirmed that the effects of the web holes may be neglected for calculating the elastic longwave buckling stress. However, strong interaction of distortional buckling with longwave buckling was observed. The validity of the results is discussed and recommendations are made when using the Direct Strength Method for wall studs with holes.

"Designing Cold-Formed Steel Using the Direct Strength Method," B. Schafer
The paper introduces the Direct Strength Method, Appendix 1 to the North American Specification for the Design of Cold-Formed Steel Structural Members, and introduces the new AISI Design Guide for the Direct Strength Method. The paper highlights some of the features of the new design guide including design examples, tutorial materials, beam and column charts, and discussion of the finer points and details pertaining to the application of the Direct Strength Method.

"Stability of Cold Formed Steel Storage Racks under Variable Loading," L. Xu, X. Wang, and H. Wang
This paper proposes an approach for evaluating the elastic buckling loads for unbraced cold-formed steel storage racks subjected to variable loading. The conventional approach of proportional loading was abandoned and the magnitude of each individual load was varied independently. The study has taken into account the volatility of magnitudes and patterns of loads and the findings can be applied to design of storage racks.

"Buckling Behavior of Cold-Formed Scaffolding Tubes," A. Hubner and H. Saal
This paper summarizes a research project on the buckling behavior of cold-formed scaffolding tubes. Experimental studies are compared with numerical approaches and comparisons with existing design codes. The results show that the current European design rules for scaffolding tubes are very conservative and suggested changes in the rules are proposed.

"Investigation of the Shear Stiffness of Profiled Steel Sheeting Diaphragms with only two edges fastened," M. Duerr and H. Saal
Available design guidelines consider the strength and stiffness of a diaphragm that has four sides fastened to members. The effect of free edges parallel to the deck span was investigated for diaphragm loading. The results of the investigation is a formula for calculating the shear stiffness of profiled steel sheeting diaphragms with only two edges fastened.

"Accumulation of Bracing Strength and Stiffness Demand in Cold-Formed Steel Stud Walls," T. Sputo and K. Beery
The problem of determining adequate bracing for multiple studs in a wall with similar imperfections is addressed. Using elastic non-linear software, the required bracing strength and stiffness demand for a single compression member that was derived by Winter was replicated. The findings indicate that the required brace strength accumulates directly with the number of braced studs. The required brace stiffness maybe determined through the use of a simple second order equation.

"Post-Buckling in the Distortional Mode and Buckling Mode Interaction of Cold-Formed Thin Walled Sections with Edge Stiffeners," D. Yap and G. Hancock
This paper discusses the analysis of post-buckling in the distortional mode of a thin-walled section with edge stiffeners and the effect of interaction of buckling modes on failure loads. The analysis is based on the longitudinal stress development and redistribution using the finite element method.

"Vibration Characteristics and Acceptability of Cold-Formed Steel Joists," Y. Chen
Discussed is a study of steel framed floor systems with cold-formed steel trusses. The objective of the study was to gain a better understanding of the vibration characteristics and to examine the floor joist system's ability to meet the vibration acceptability criteria of the AISC design guide Floor Vibrations Due to Human Activity.

"Impact of Hole on the Elastic Buckling of Cold-Formed Steel Columns with Application to the Direct Strength Method," C. Moen and B. Schafer
The paper presents the findings of a study that focused on the elastic buckling behavior of plates and cold-formed steel C-section compression members containing a single hole. Parametric studies evaluated the effect of either slotted or

circular holes in Steel Stud Manufacturer's Association stud sections. Favorable comparisons are made between tested specimen strength and predicted strength using the Direct Strength Method.

"Cold-Formed Steel Angles Under Axial Compression," G. Chodraui, Y. Shifferaw, M. Malite, and B. Schafer
This paper examines the stability and strength of concentrically loaded cold-formed steel angle as determined by (i) numerical methods, (ii) experimental, and (iii) effective width and Direct Strength based methods. The results indicate that the design practice of ignoring local/torsional buckling as a global mode and only considering it as a local mode may not be conservative in some circumstances.

"Buckling Analysis of Cold-Formed Steel Members Using CUFSM: Conventional and Constrained Finite Element Methods," B. Schafer and S. Adany
This paper provides technical background and illustrative examples for stability analysis of cold-formed steel members using conventional and constrained finite strip methods. The conventional finite strip method combined with the constrained finite strip method provides a powerful tool for understanding cross-section stability in cold-formed steel members.

"Bolted Tension Member Design - A New Approach," D. Fox and R. Schuster
Summarized is a study that examines the behavior of single-bolted tension members and develop an appropriate design method. Based on an extensive data base of over 900 tests, a unified design approach is suggested for possible adoption by the AISI Specification.

"GBT-Based Analysis of the Local and Global Buckling Behavior of cold-Formed Steel Frames," C. Basaglia, D. Camotim, and N. Silvestre
This paper reports the results of an ongoing investigation on the use of Generalized Beam Theory (GBT) to assess the global and local buckling behavior of cold-formed steel frames. A brief overview of the main concepts is discussed and procedures involved in performing a GBT buckling analysis presents the formulation and implementation of GBT-based beam finite element including global and local deformation modes. The application of the method is presented for a simple "L-shaped" frame.

"Effective Width Method Based Design for Distortional Buckling of Cold-Formed Steel Beams," C. Yu and T. Lokie
The paper presents an Effective Width concept based design method for distortional buckling of cold-formed steel Z- and C-section beams. The proposed method is based on the current design procedure in the AISI specification and enables engineers to predict the distortional buckling strength of Z- and C-sections using the existing effective width method. The proposed method shows good agreement with experimental results as well as Direct Strength Method predictions.

"Shear Lag Effect on Bolted L-Shaped Cold-Formed Steel Tension Members," C. Pan
A study of L-shaped members with different cross-section dimensions were tested for both one-line and two-line bolted connections. Experimental results show a discrepancy between the test results and the predicted capacity for L-shapes with large non-connected elements. A more effective model is proposed for determining the capacity.

"Web Crippling of Sigma-Shaped Metal Studs in a Wall Assembly," M. Boylan, E. Sumner, N. Rahman, and E. diGirolamo
The details and results of an ongoing investigation of a sigma-shaped cold-formed steel stud subjected to web crippling and axial loading is presented. Some tests were conducted without axial load to examine the effect of axial load on the web crippling strength.

"Elastic Post-Buckling Behavior of Uniformly Compressed Plates," M. Bakker, M. Rosmanit, and H. Hofmeyer
This paper discusses how existing analytical and semi-analytical formulas for describing the elastic-post-buckling behavior of uniformly compressed square plates with imperfections can be simplified and improved. The existing and improved formulas are compared to the results of finite element simulations.

"Increasing the Strength and Stiffness of Cold-Formed Hollow Flange Channel Sections for Web Crippling," T. Wilkinson, P. Liu, J. Magpayo, and H. Nguyen
Outlined is an investigation of the strength of a new hollow flange C-section for the interior-one-flange web crippling con-

dition. Novel methods of stiffening and strengthening the resistance to web crippling are presented and methods of evaluating the strength are considered.

"AISI Standards for Cold-Formed Steel Framing," J. Larson
This paper provides an overview of the significant documents that have been produced by the AISI Committee on Framing Standards and the paper describes the ongoing work of the committee. To date six ANSI-approved, building code adopted, 2004 edition standards have been developed along with a code of standard practice.

"AISI Test Procedures for Cold-Formed Steel Structural Members and Connections," H. Chen, R. LaBoube, T. Murray, and T. Sputo
Since 2001 four new test procedures have been developed and four previously published test procedures have been updated. This paper provides an overview of the new test standards and summarizes the changes to the existing test standards.

"Direct Strength Method for Lipped Channel Columns and Beams Affected by Local-Plate/Distortional Interaction," N. Silvestre, P. Dinis, and D. Camotim
Reported are the results of an investigation on the use of the Direct Strength Method to estimate the ultimate strength of lipped channel cold-formed steel columns and beams affected by interaction phenomena involving local-plate and distortional buckling modes. The ultimate strength of both columns and beams based on finite element analysis is compared with estimates provided by existing Direct Strength Method equations. On the basis of the comparison needed additional features are identified for the Direct Strength Method.

"iSpan, A Light Steel Floor System," D. Fox, R. Schuster, and M. Strickland
Described in the paper is a cold-formed steel floor system that is comprised of a unique floor joist. The floor joist is fabricated by fastening two cold-formed steel elements to a flat web resulting in a visual I-type cold-formed steel section. Summarizes is an extensive test program to substantiate the structural performance for flexure, shear, and web crippling.

"Analysis of Conventionally Framed Hip Roofs Using Cold-Formed Steel Members," L. Waldo, S. Stephens, and R. LaBoube
This paper summarizes an investigation of the behavior of conventionally framed cold-formed steel roof framing members using elastic finite element analysis methods. The roof system as a whole was considered in the analysis, including the contribution of the sheathing and ceiling joists.

"Distortional Buckling of Simple Lipped Channel in Bending - Results of the Experimental Analysis versus Direct Strength Method," C. Javaroni and R. Goncalves
Discussed are the procedures and results obtained from an experimental study of cold-formed steel members in bending. The cross-section dimensions for the lipped channels were chosen so that distortional buckling was the principal failure mode. The experimental results are compared with the Direct Strength Method solution.

"A Detailed Examination of Interactive Buckling in Plain Channel Sections," A. Aziz, J. Rhodes, M. Macdonald, and D. Nash
A finite element analysis that focused on elastic buckling of columns is presented. The key points of interest for the study were the affect of the wandering neutral axis and the assumed effective length of the column. The veracity of assumptions such as the movement of the neutral axis is counteracted by the effects of the fixed end are considered.

"Development of a Portal Frame System on the Basis of Component Testing," J. Rhodes and R. Burns
This paper describes tests carried out on components of a cold-formed steel portal frame system. The main aim of the tests was to validate the design which was initially based on finite element software.

"Lateral Distortional Buckling Behaviour of a New Cold-Formed Steel Hollow Flange Channel Section," D. Mahaarachchi and M. Mahendran
Presented are the details of a finite element mode suitable for buckling and non-linear analysis of a hollow flange channel section as a flexural member. Also discussed is an experimental study of the section. Verification of the finite element model is presented.

"Section Moment Capacity of a New Cold-Formed Steel Hollow Flange Channel Section," M. Mahendran and D. Mahaarachchi
This paper describes a series of 16 section capacity tests of a hollow flange channel. The tested cross-section moment capacities were compared with predictions from the current steel structures design standards. Based on the study's findings, appropriate design recommendations are proposed.

"Influence of Non-Structural Components on Roof Diaphragm Stiffness of Single-Storey Steel Buildings," S. Mastrogiuseppe, C. Rogers, R. Tremblay, and C. Nedisan
Reported are the findings of research to better understand the influence of non-structural roofing components on the performance of single-storey steel buildings subjected to seismic loading. Non-structural components that were considered in the study include gypsum board, fibreboard and polyisocyanurate insulation. The analytical results obtained from a linear finite element analysis were compared with test results. The model was then use to establish stiffness values for diaphragm configurations in which deck thickness and connector pattern were varied.

"Finite Element Analysis of Web Crippling Behaviour of Cold-Formed Steel Flexural Members," M. Macdonald, M. Heiyantuduwa, and J. Rhodes
Illustrated is the use of finite element analysis to model the interior-one-flange loading web crippling behaviour of cold-formed steel flexural members. The influence of various geometric parameters on the web crippling strength was investigated. The results from the finite element study were compared and validated against experimental results.

"A Simplified Method of Evaluating Lateral Strengths of Shear Wall Panels with Cold Formed Steel Framing," L. Xu and J. Martinez
A simplified method for computing the lateral strength of shear wall panels is presented by this paper. The proposed simplified method when compared with recent experimental results demonstrated good agreement. The method is easily applied in engineering practice.

"Lateral Response of Sheathed Cold-Formed Shear Walls: An Analytical Approach," L. Fiorino, G. Della Corte, and R. Landolfo
In this paper a method for predicting the non-linear shear versus top wall displacement relationship of sheathed cold-formed steel shear walls is proposed. The method relies on the availability of screw connection test results. The comparison of analytical results with available wall test results shows good agreement.

"Testing and Design of Light Gauge Steel Frame / 9 mm OSB Panel Shear Walls," C. Blais and C. Rogers
The paper summarizes the testing and evaluation of shear walls sheathed with 9 mm OSB panels. The equivalent energy elastic-plastic analysis technique was implemented in the calculation of design parameters to include nominal shear strength, elastic stiffness and system ductility.

"Pushover test of Pitched Roof Portal Frames of Built-up Cold-Formed Steel Sections," D. Dubina, Z. Nagy, L. Fulop, and A. Stratan
This paper summarizes the results of an experimental study conducted to evaluate the performance of pitched roof cold-formed steel portal frames. The frames were constructed using back-to-back C-sections and bolted connections. Agreement between an analytical method and experimental results is presented.

"MBMA-Sponsored Cold-Formed Steel Research 50th Anniversary Retrospective," L. Shoemaker
The Metal Building Manufacturers Association was established in 1956 and has been heavily involved in cold-formed steel research over the years. Provided is a chronology of MBMA sponsored cold-formed steel research that has been instrumental in shaping the North American Specification for the Design of Cold-Formed Steel Structural Members.

"Influence of Insulation on the Shear Strength of Screw Connections," A. Lease and S. Easterling
A study that was focused on assessing the affect of insulation on the strength of single shear screw connections is reported in this paper. Fiberglass insulation was placed between the two sheets of the single shear connection and tested to failure. The results of the tests and analytical comparisons is presented.

"The New SDI Diaphragm Design Manual," D. Li
This article summarizes and describes in each section the changes made with the third edition publication of the Steel

adapted for ASD and LRFD methods. The third edition reflects the provisions of Table D5 of the North American Specification for the Design of Cold-Formed Steel Structural Members, 2001 edition with 2004 supplement.

"Organizations and the Move toward Standardization in the North American Cold-Formed Steel Framing Industry," D. Allen

This paper will cover a brief history of standardization in the light-steel framing industry, reasons for the standardization, obstacles encountered and the current state of framing manufacturing and standardization in North America. The paper ncludes regulatory and manufacturing obstacles encountered and discuss future steps in the standardization process.