SIM OUEST

2000

CONFERENCE B5.3

ALPS/ULSAP Software for Ultimate Strength Design of Steel Grillages under Combined Biaxal Compression/Tension, Biaxal Inplane Bending, Edge Shear and Lateral Pressure Loads

J.K PAIK *(Pusan National University - Korea)*
O.F. HUGHES *(Virginia Techn. - USA)*
C.TODERAN *(ANAST - Univèrsité de Liège)*
P. RIGO *(ANAST - Université de Liège)*

SIMOUEST Marine 2000 – 29 & 30 November 2000

SIM OUEST

2000

29 & 30 Novembre / *November* 2000
NANTES / FRANCE

Lieu : Ecole Centrale de Nantes

ACTES DU CONGRES EUROPEEN
PROCEEDINGS OF THE EUROPEAN CONFERENCE

MARINE - Industrie & Simulation
MARINE TECHNOLOGY - Industry & Simulation

TOME 2 / *PART 2* : Salle B / *Room B*

Organisé par / *Organised by* :

ALSTOM DCN ECN

En Association avec / *In Association with* :

GE4U

En partenariat avec / Sponsored by :

Région des Pays de la Loire

LOIRE ATLANTIQUE CONSEIL GENERAL

DISTRICT AGGLOMERATION NANTAISE

ANVAR

JEUDI 30 NOVEMBRE 2000 /

THURSDAY 30TH NOVEMBER 2000

08:30 Accueil des participants /
Welcoming of the participants

09:00 Conférencier invité / Invited speaker : Dr ZARKA « **Intelligent optimal design of materials and structures** »

SESSION A4 : TRAINING HLA

Jeudi / Thursday 9:30 – 10:20

A4.1 **Adapting a bridge simulator to HLA - the challenges**
S. COTE (Norcontrol – Norway)

A4.2 **Building a Naval Combat System Simulation Environment with HLA**
S.A.WHITE (DERA – Hampshire)

SESSION B4 : HULL Products 2

Jeudi / Thursday 9:30 – 10:20

B4.1 **On calculations of Shaft Alignment and Bending vibrations in early design stages**
B. BOHLMANN (FSG – Flensburg)

B4.2 **Numerical simulation in order to study a large passenger ship**
X. LE NOELLEC (Chantiers de l'Atlantique – Nantes) / G. BABAUD (IRCN – Nantes)

SESSION C4 : TOOLS FOR SIMULATION Solutions, performance & planning

Jeudi / Thursday 9:30 – 10:20

C4.1 **Simulations to Improve Ship Safety and Functions**
M. KANERVA / M. AARNIO (Deltamarin / Finland)

C4.2 **Developing an automatic path following system for a mine-hunting vehicule**
R. ETEKI (ECA – Toulon) / S. DELAUNEY (DGA/DCE - Montreuil-Juigné) / S. NICOLAD (PROLEXIA - Six fours les plages)

11:20 PAUSE CAFE / COFFE BREAK

SESSION A5 : TRAINING VR & AI

Jeudi / Thursday 10:50 – 12:30

A5.1 **Interconnection of simulations in an HLA federation**
P. SOULARD (DCN – Ruelle)

A5.2 **Vessel management expert system**
T. TRAN (ISIS - University Southampton)

A5.3 **Interactive Visual Simulation**
B. JAMES (DERA – Worcestershire)

A5.4 **Simulations and virtual reality visualisation for design and training**
P. BROAS J.MARTIO (VTT Manufacturing Technology – Finlande) / J. MATUSIAK / M. MAESALU (Technical University of Helsinki)

SESSION B5 : HULL Damages

Jeudi / Thursday 10:50 – 12:30

B5.1 **LBR-5 A ship hull optimisation tool**
P. RIGO / A. HAGE (ANAST – Université de Liège)

B5.2 **Life-Cycle fatigue reliability of ship structures : an integrated approach**
S. V. PETINOV (Marine Technical University of St. Petersburg)

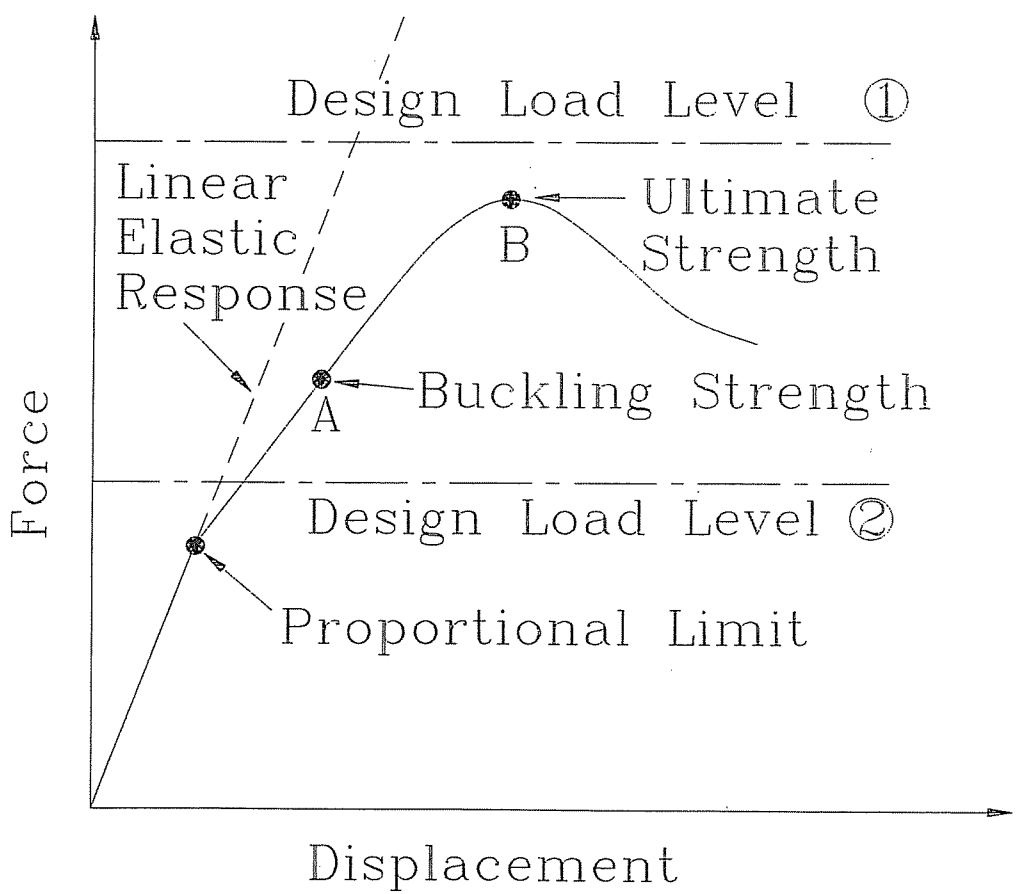
B5.3 **ALPS/ULSAP Software for Ultimate Strength Design of Steel Grillages under Combined Biaxal Compression/Tension, Biaxal Inplane Bending, Edge Shear and Lateral Pressure Loads**
J.K PAIK (Pusan National University – Korea) / O.F. HUGHES (Virginia Techn. – USA) / C. TODERAN / P. RIGO (ANAST – Université de Liège)

B5.4 **Fatigue analysis of high speed craft welded assemblies**
F. JANCART (IRCN – Nantes)

ALPS/ULSAP Software for Advanced Ultimate Strength Design of Steel Grillages under Combined Biaxial Compression / Tension, Biaxial In-plane Bending, Edge Shear and Lateral Pressure Loads

by
J.K. Paik, Pusan National Univ., Korea
O.F. Hughes, Virginia Tech., USA
C. Toderan, P. Rigo, Univ. of Liege, Belgium

Ultimate Strength Design Concept



ALPS = Analysis of Large Plated Structures

ULSAP = ULtimate Strength Analysis Program based on more sophisticated design formulations

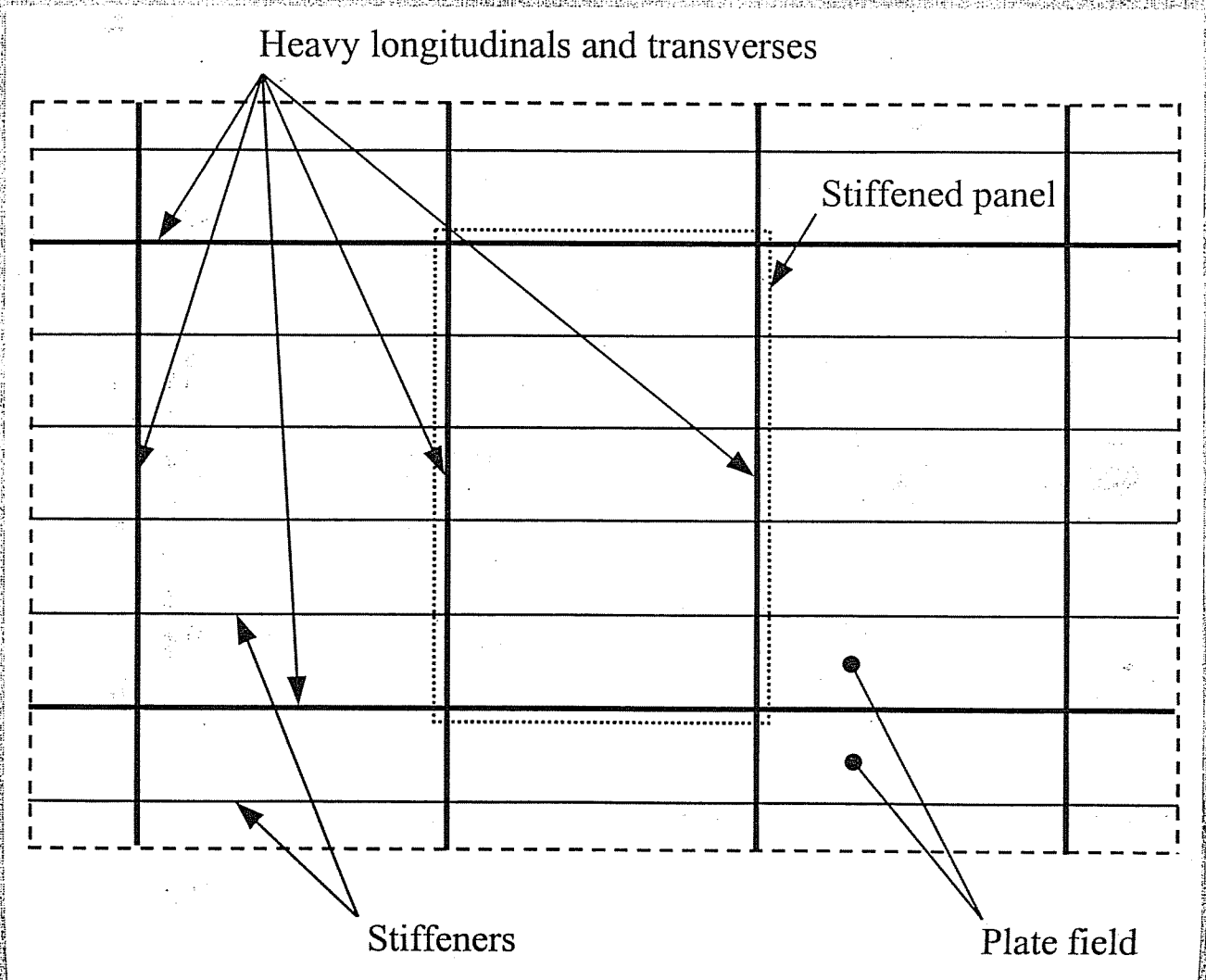
Developer: J.K. Paik, Pusan National Univ.

http://ssml.naoe.pusan.ac.kr

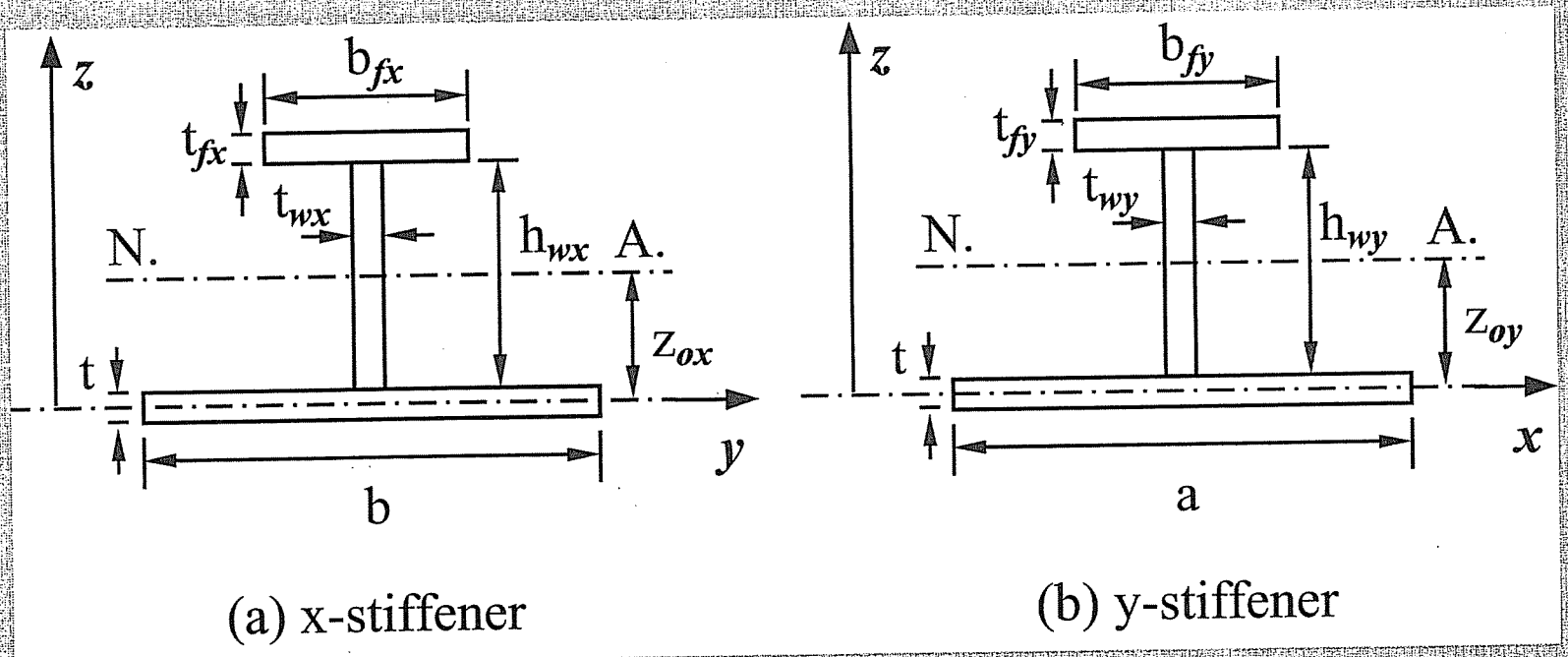
Distributor: Proteus Engineering, USA

http://www.proteusengineering.com

Typical Plated Structures



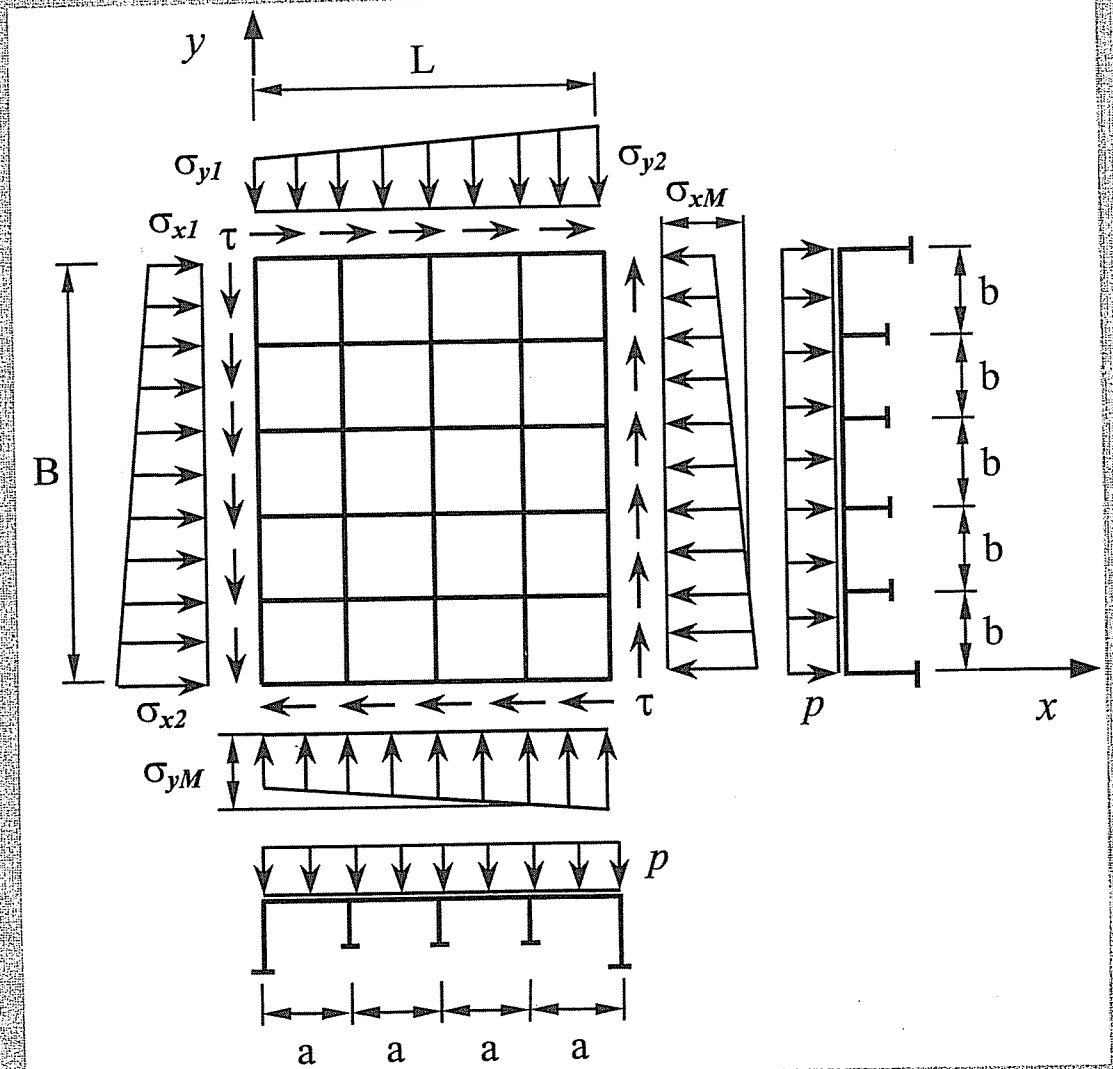
Geometry of Support Members



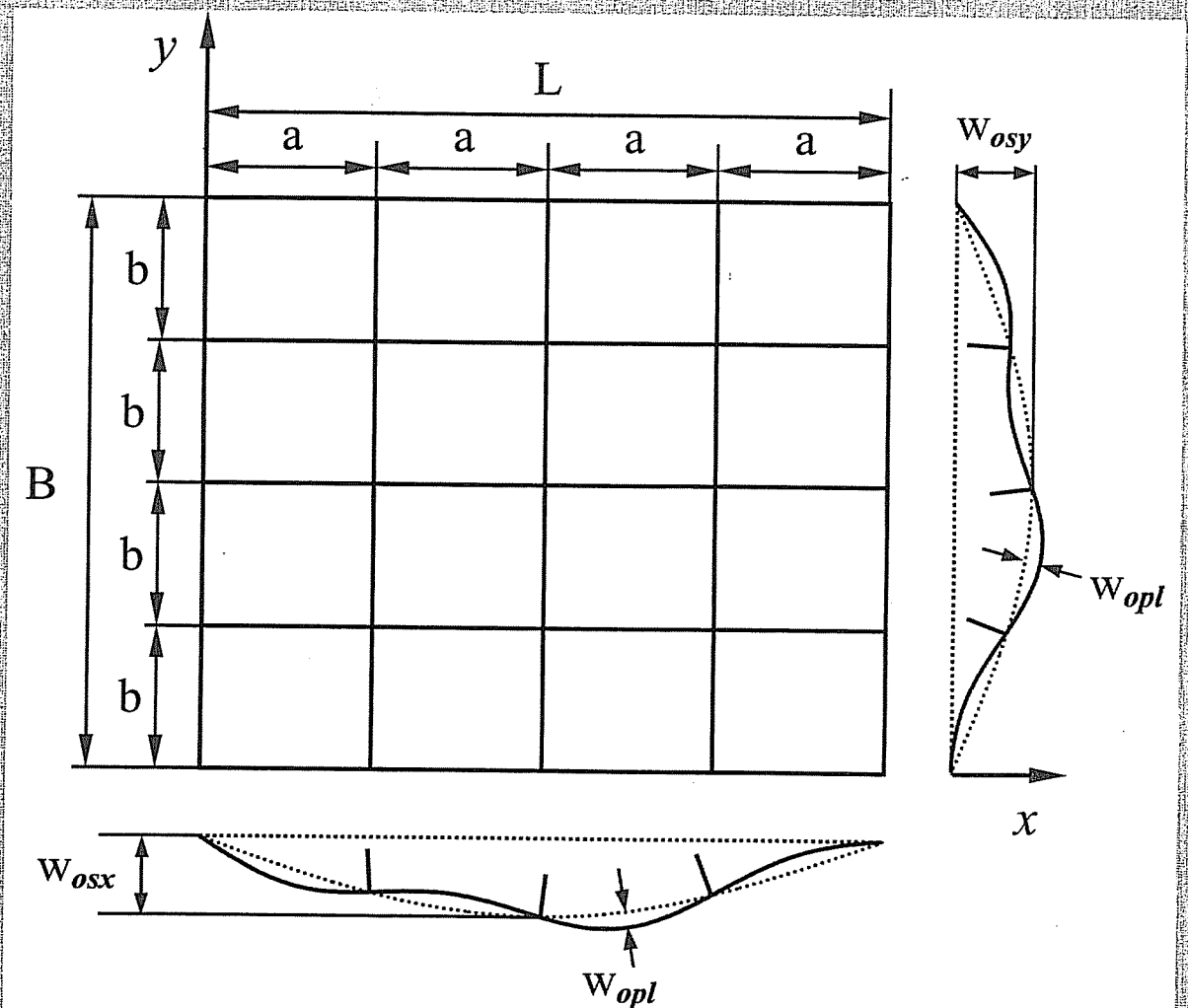
Influential Factors Affecting Behavior of Plated Structures:

- Geometric / material properties
- Loading characteristics
- Initial imperfections
- Boundary conditions
- Structural deterioration

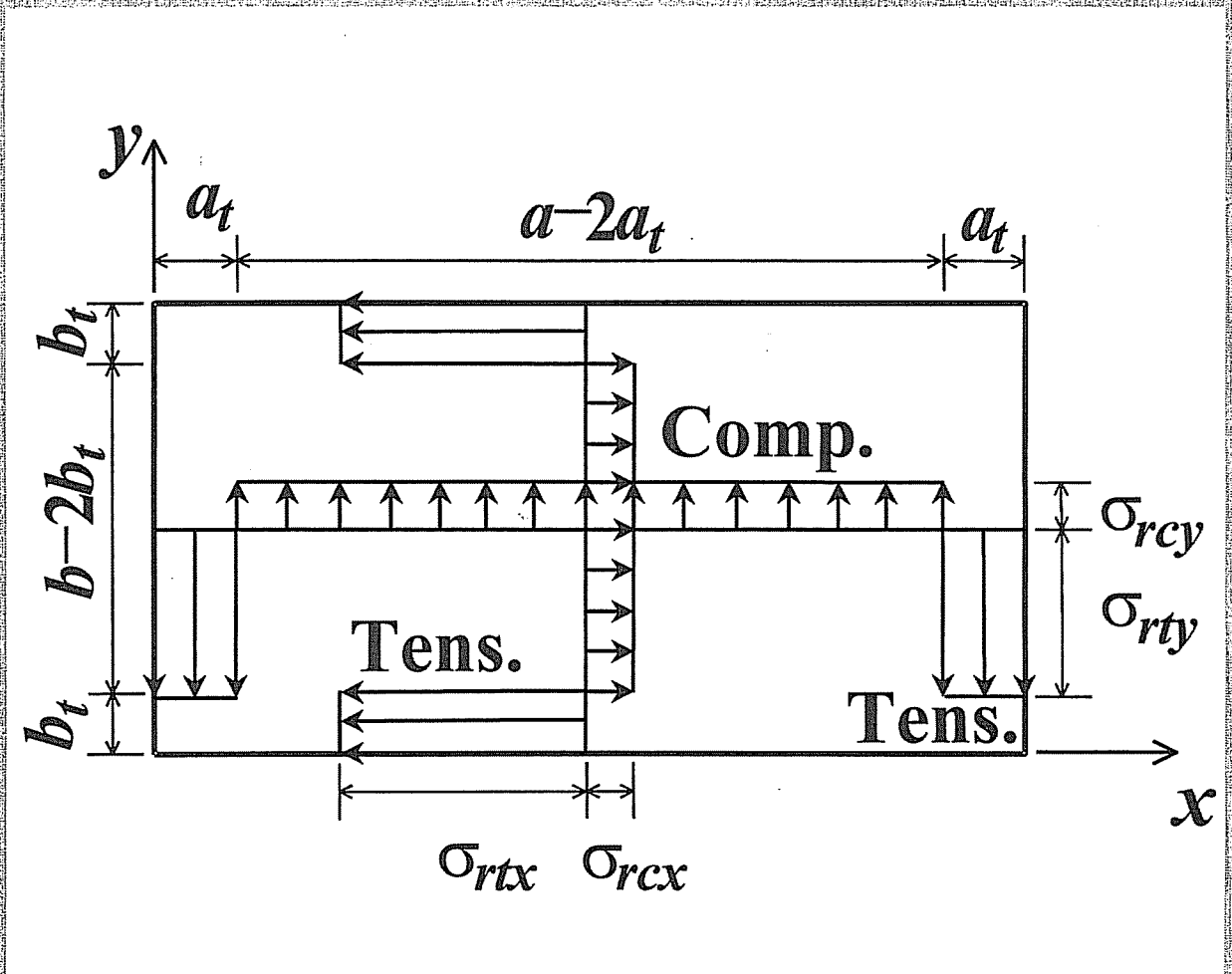
Load Application



Initial Distortions



Welding Induced Residual Stresses



LRFD Criterion

$$\sigma_a / \sigma_c < \eta$$

where

σ_c = ultimate limit state capacity

σ_a = load effects

η = usage factor

* LRFD = Load - Resistance Factor Design

Primary Collapse Modes for ULS of a Stiffened Panel / Grillage

Mode I: Overall collapse after overall buckling

Mode II: Yield at plate-stiffener intersection

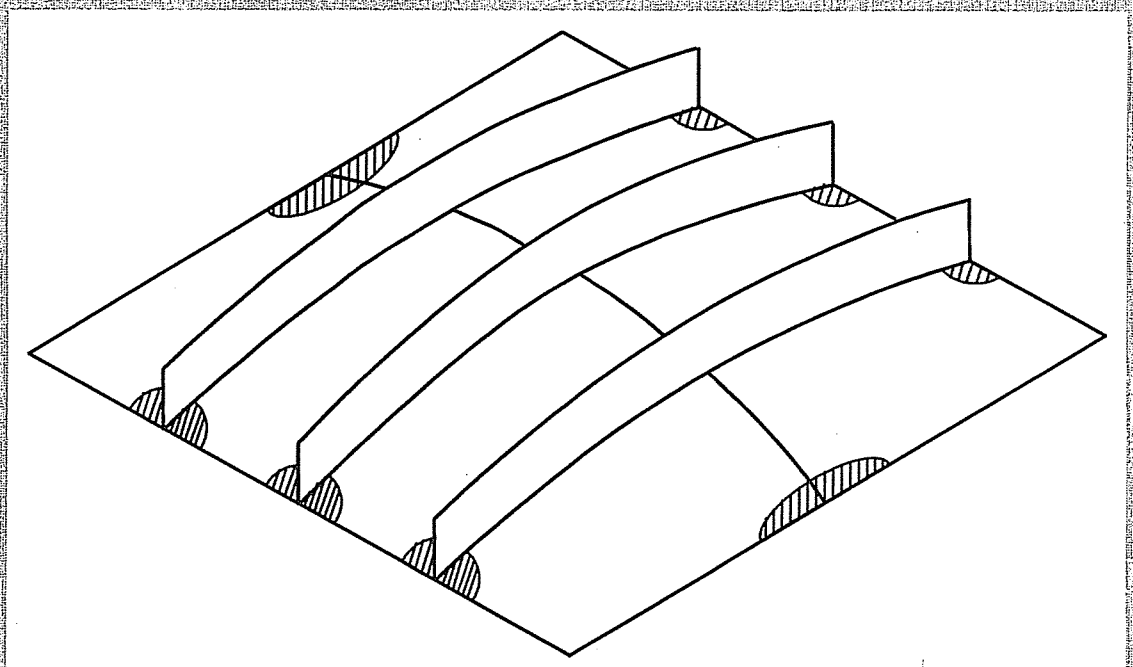
Mode III: Column/beam-column type collapse

Mode IV: Local buckling of stiffener web

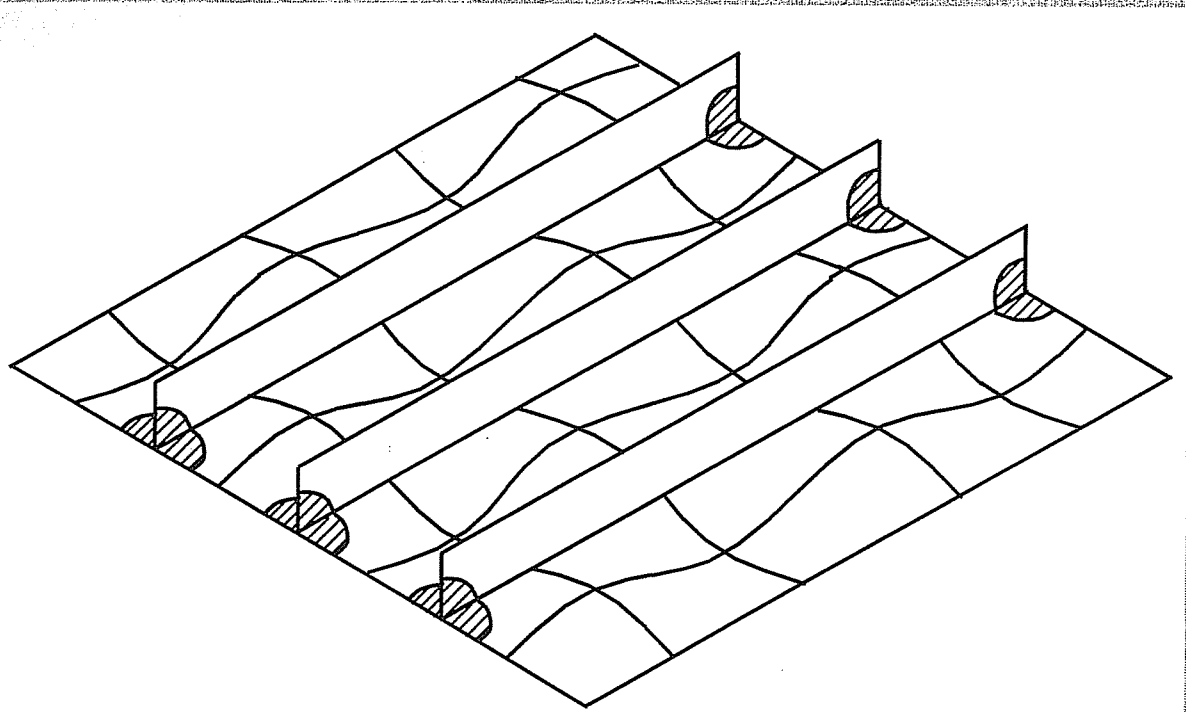
Mode V: Tripping of stiffener

Mode VI: Gross yielding

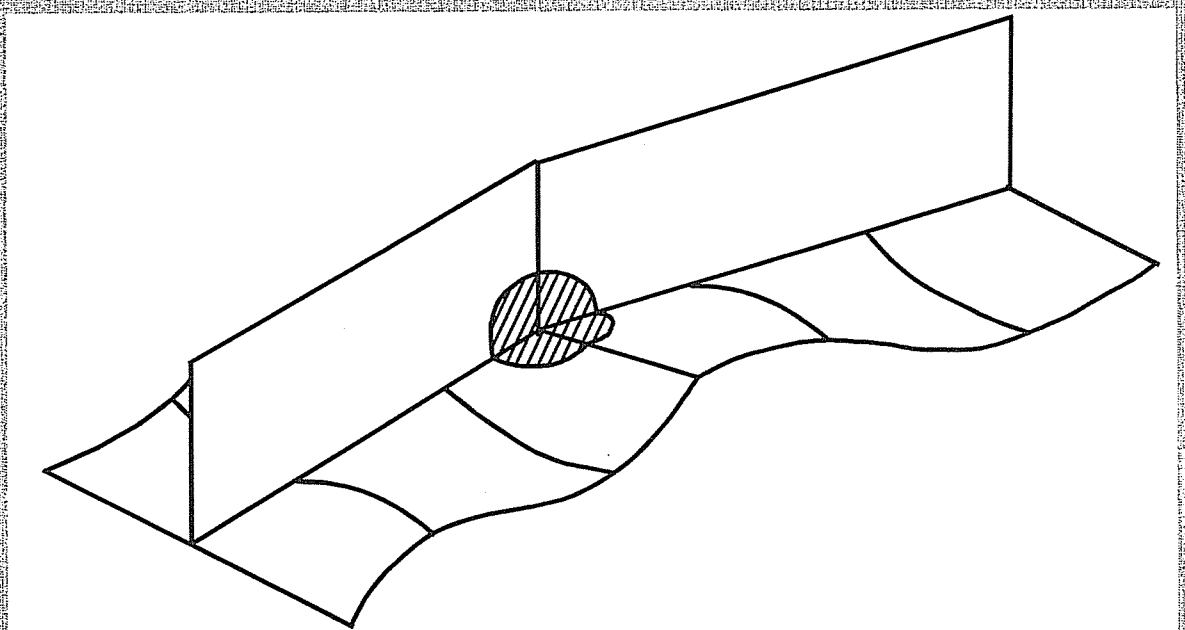
* ULS = Ultimate Limit State



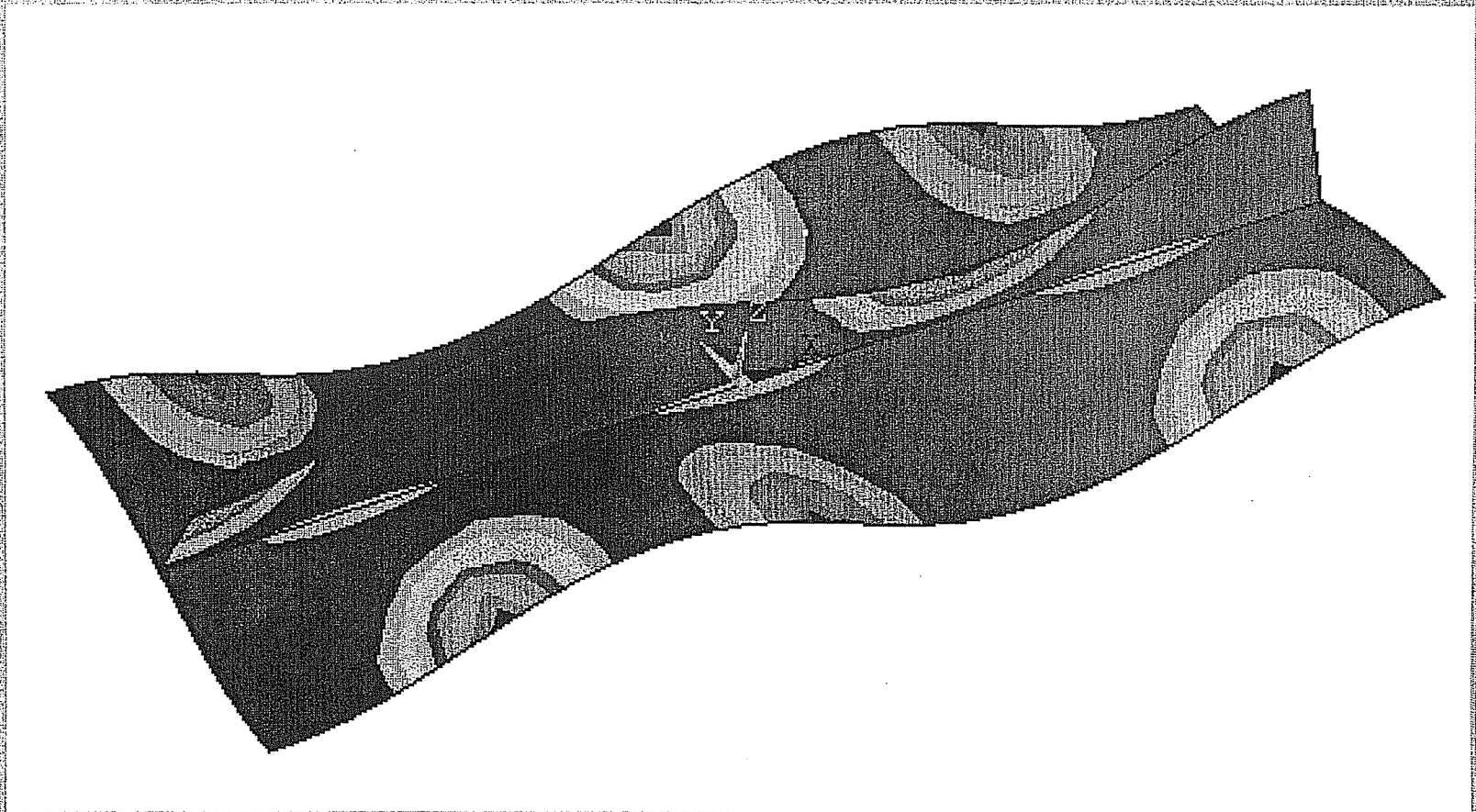
Mode I: Overall collapse after overall buckling



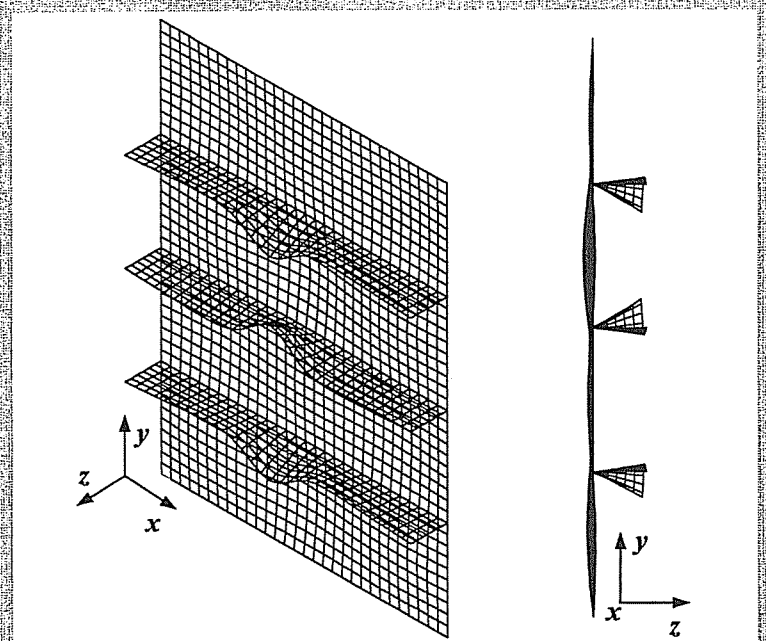
Mode II: Yield at plate-stiffener intersection

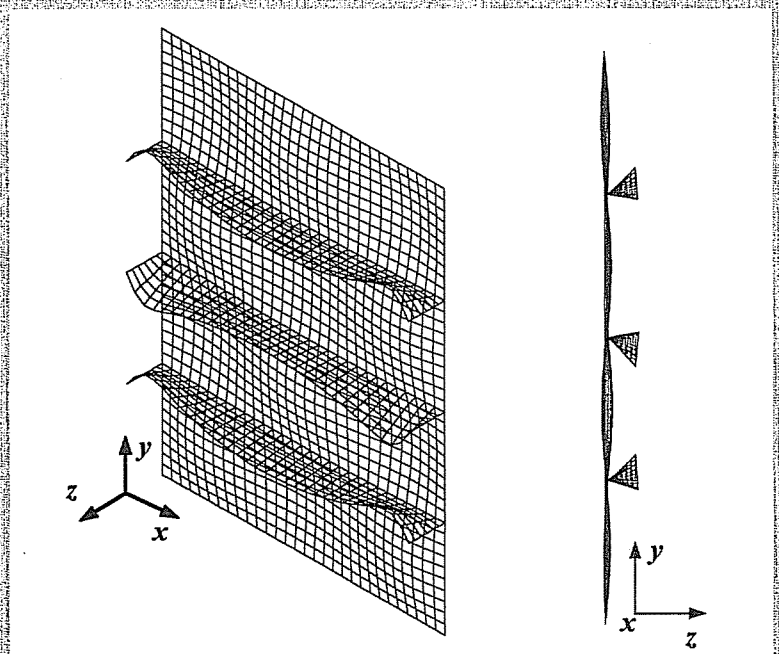


Mode III: Column or beam-column type collapse



Mode IV: Local buckling of stiffener web

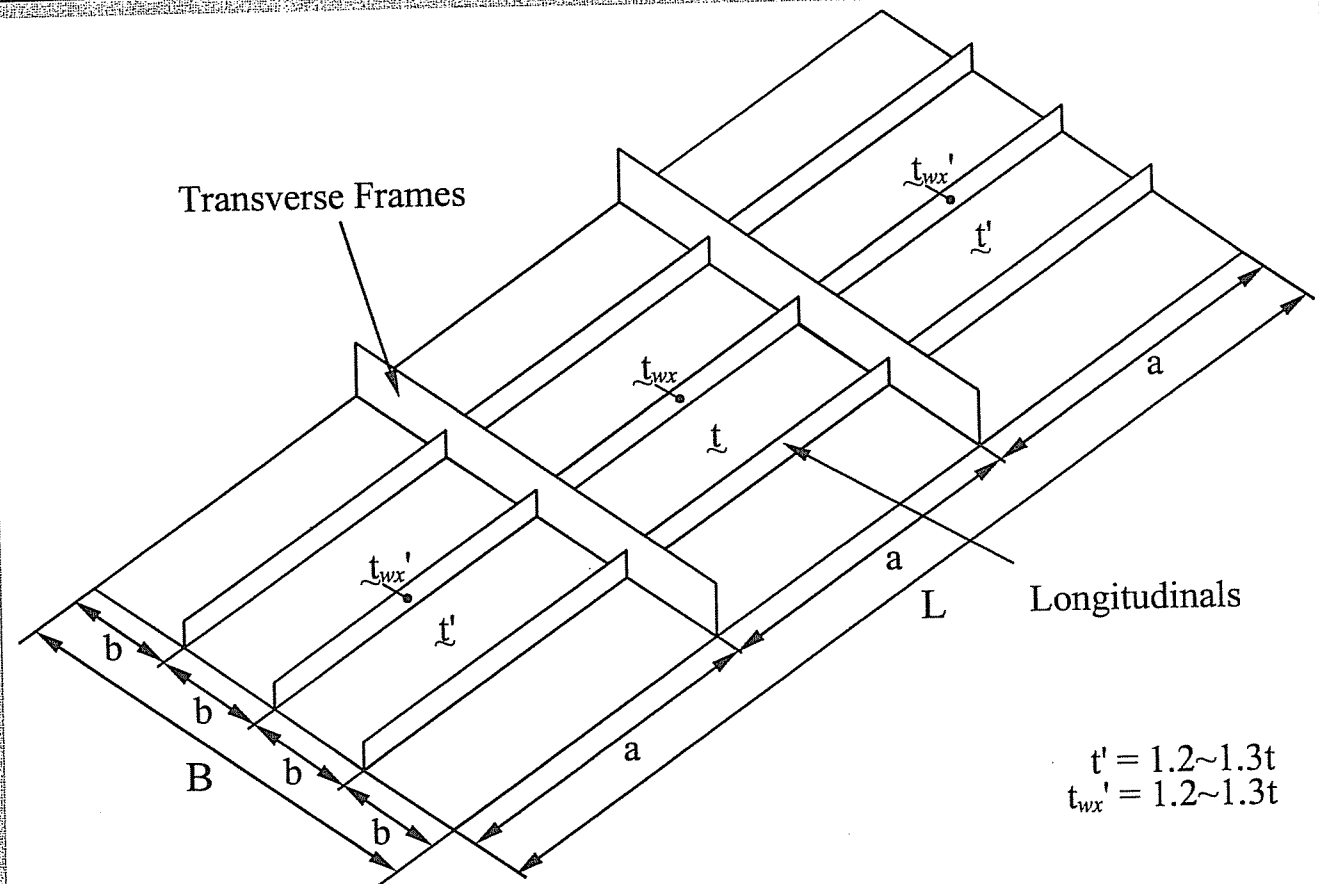




Mode V: Tripping of stiffener

Real ultimate strength of stiffened panels / grillages
In ALPS/ULSAP computations:
is
taken as
minimum value among ultimate strengths
as those obtained
based on the six collapse modes, i.e.,
Mode I ~ Mode VI.

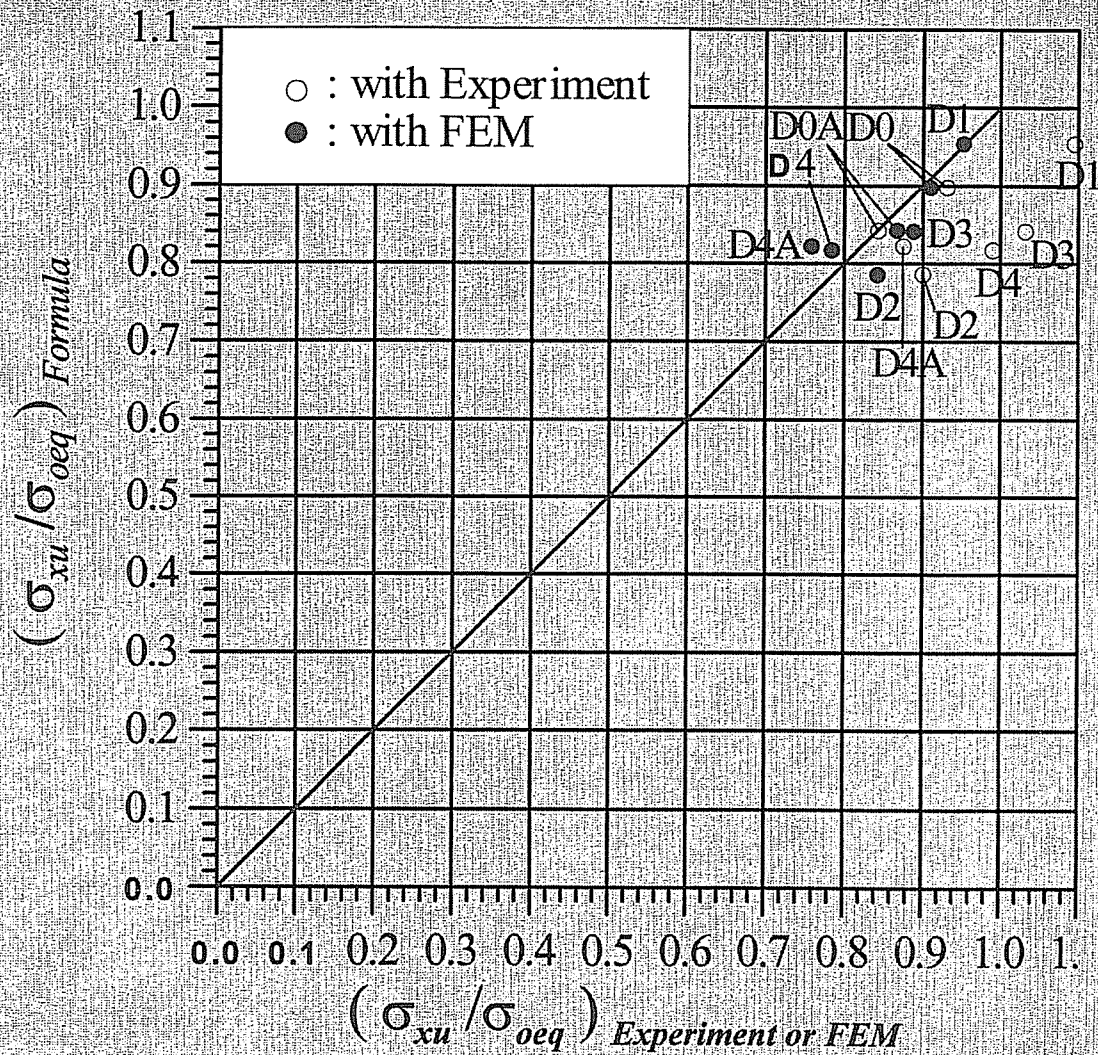
Verification Examples



Mechanical Tests of Tanaka - Endo (1988) In Uniaxial Compression

L = 3240 mm, B = 1440 mm, t = 4.38~6.15 mm

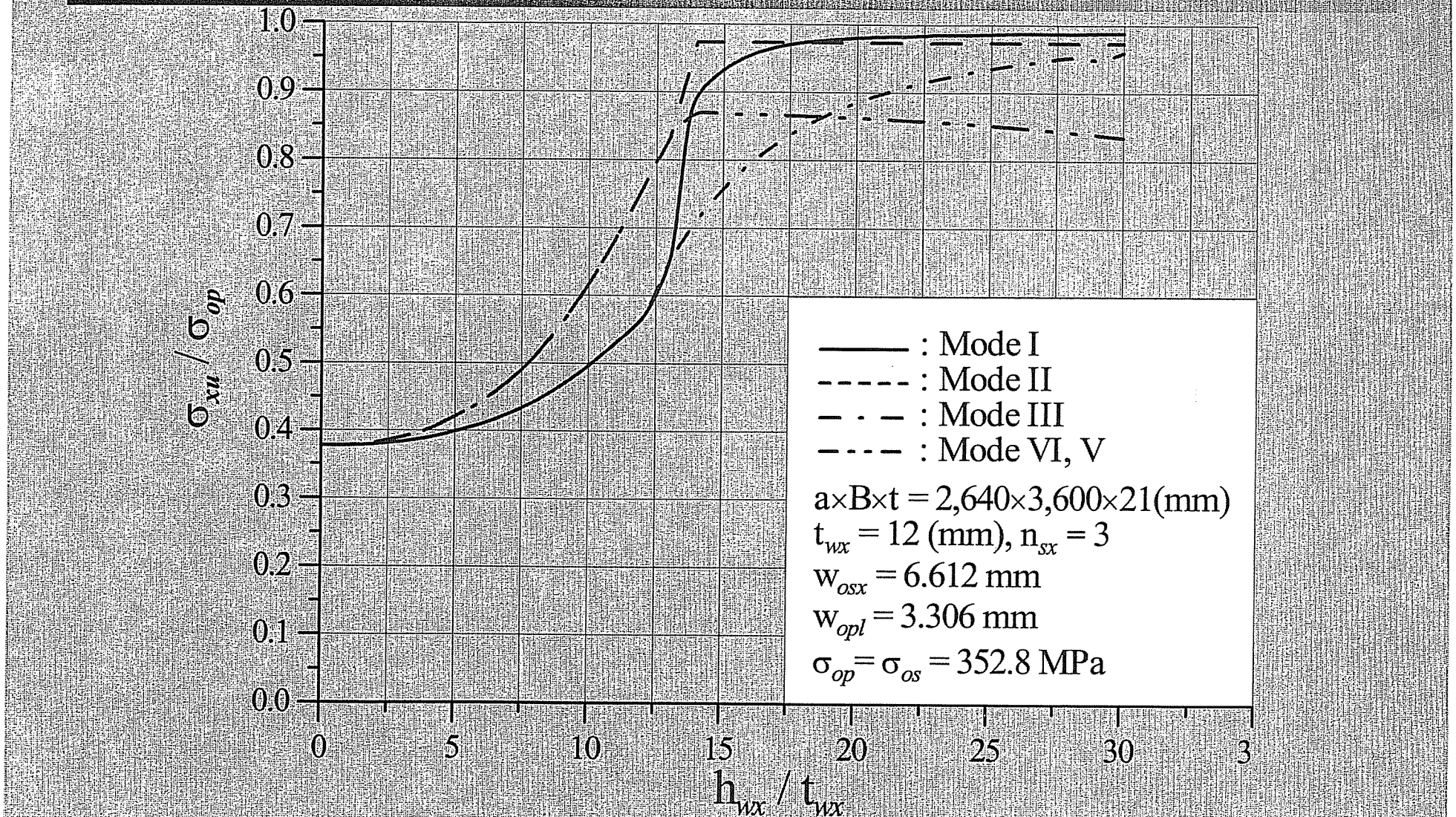
Verification Examples



Bias = 0.898, COV = 0.079 against Tanaka-Endo Tests

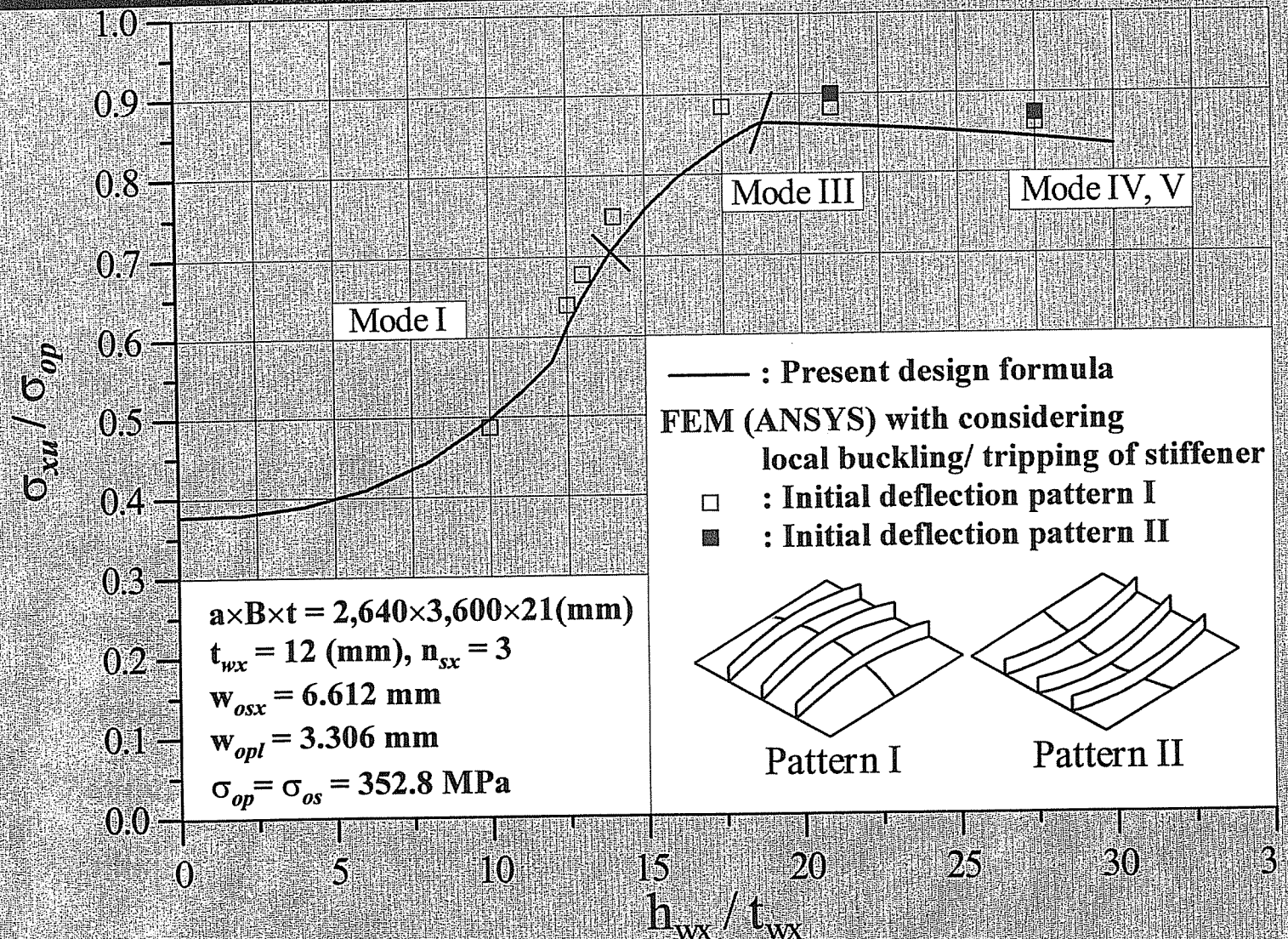
Bias = 0.995, COV = 0.053 against FEA

Verification Examples



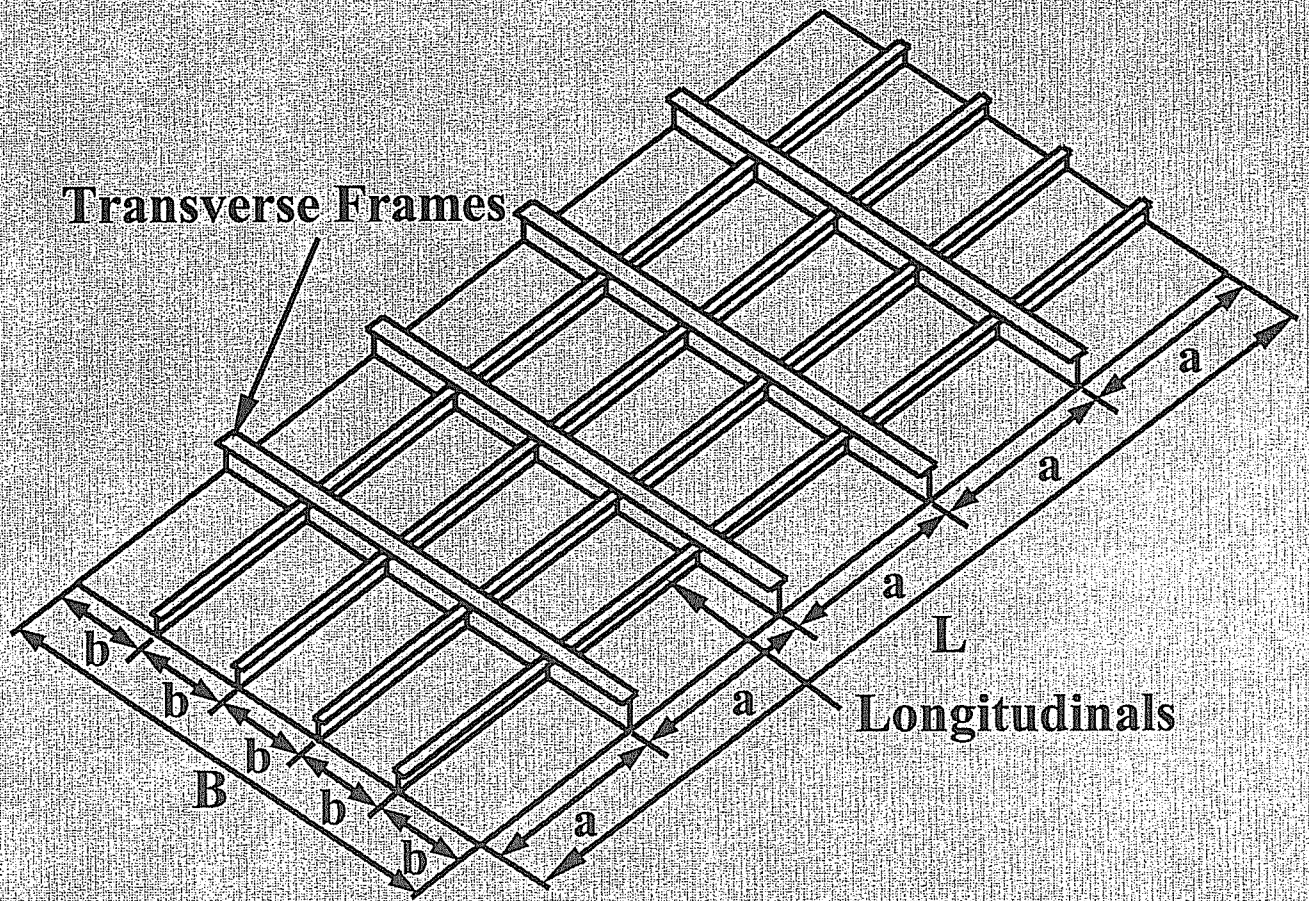
Uniaxially Stiffened Panel in Uniaxial Compression

Verification Examples



Uniaxially Stiffened Panel in Uniaxial Compression

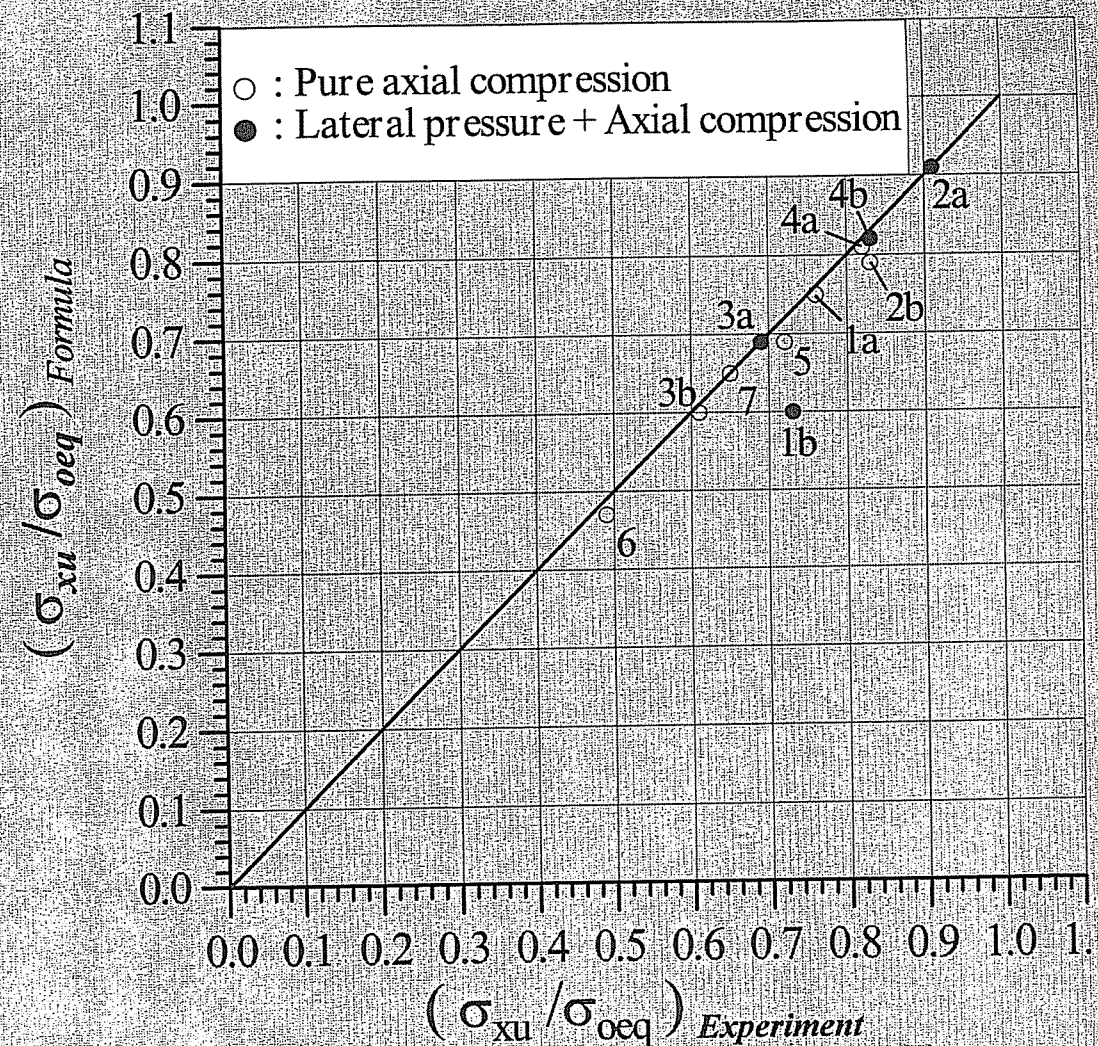
Verification Examples



Mechanical Tests of Smith (1976) for grillages in Combined Uniaxial Compression and Pressure

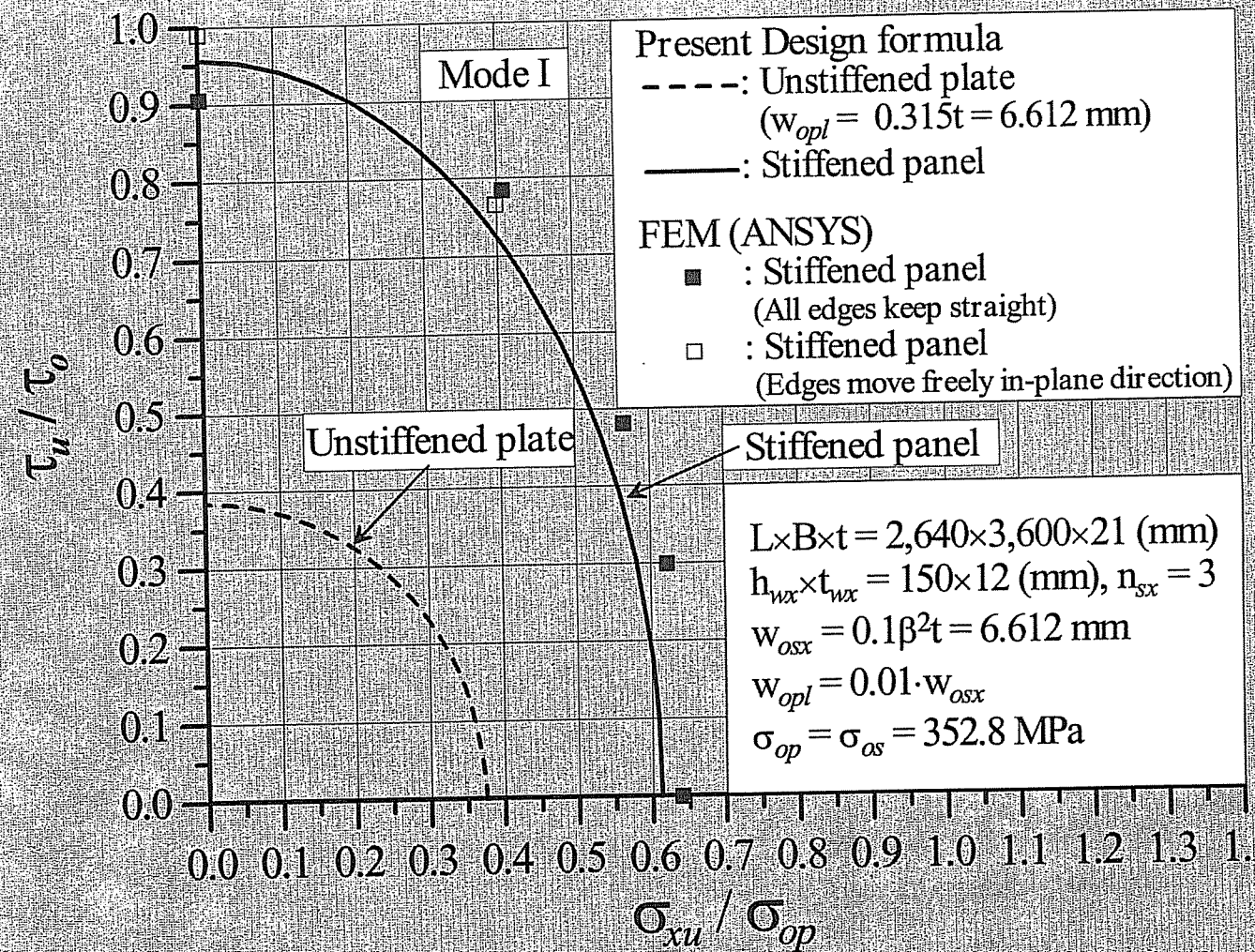
L = 6096 mm, B = 3048 mm, t = 6.3~8.0 mm

Verification Examples



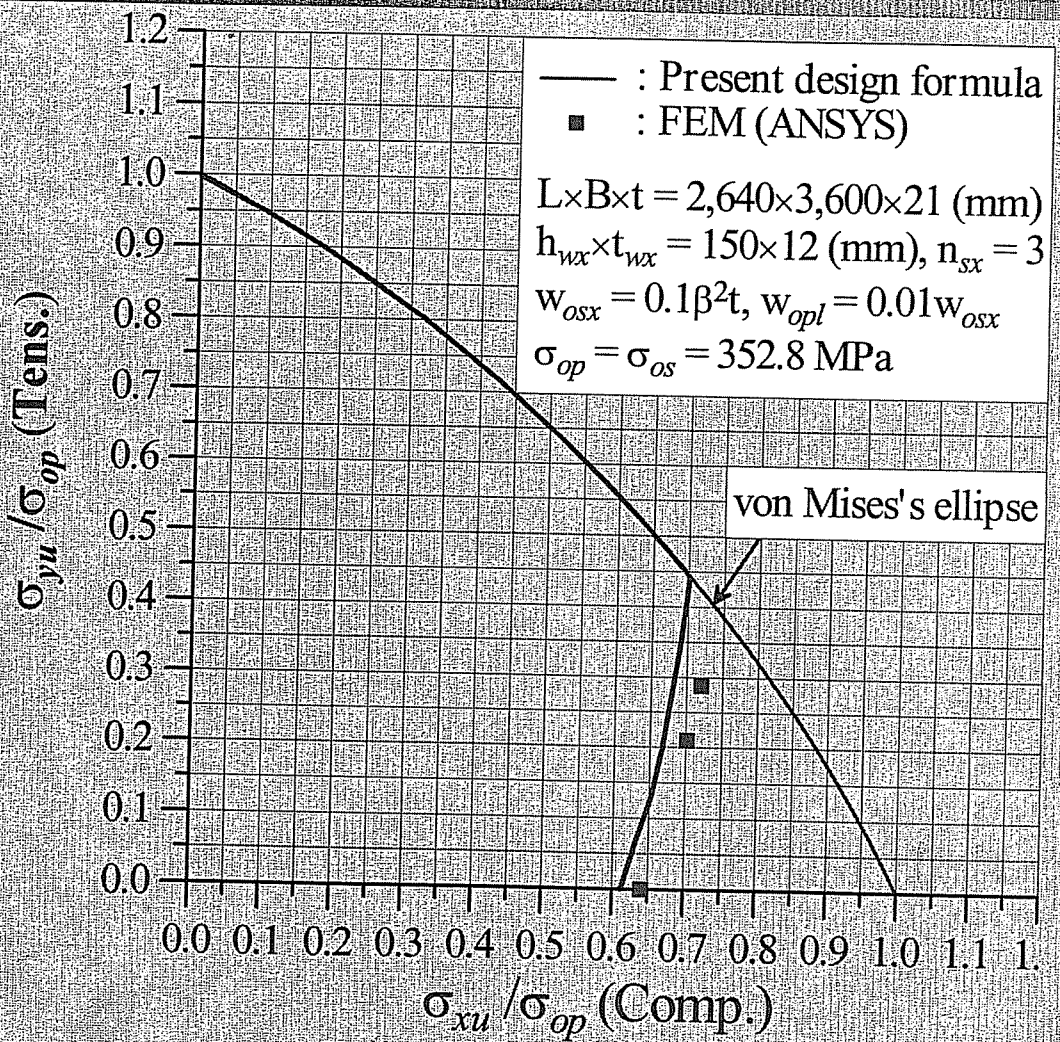
Bias = 0.967, COV = 0.053 against the Smith Tests

Verification Examples



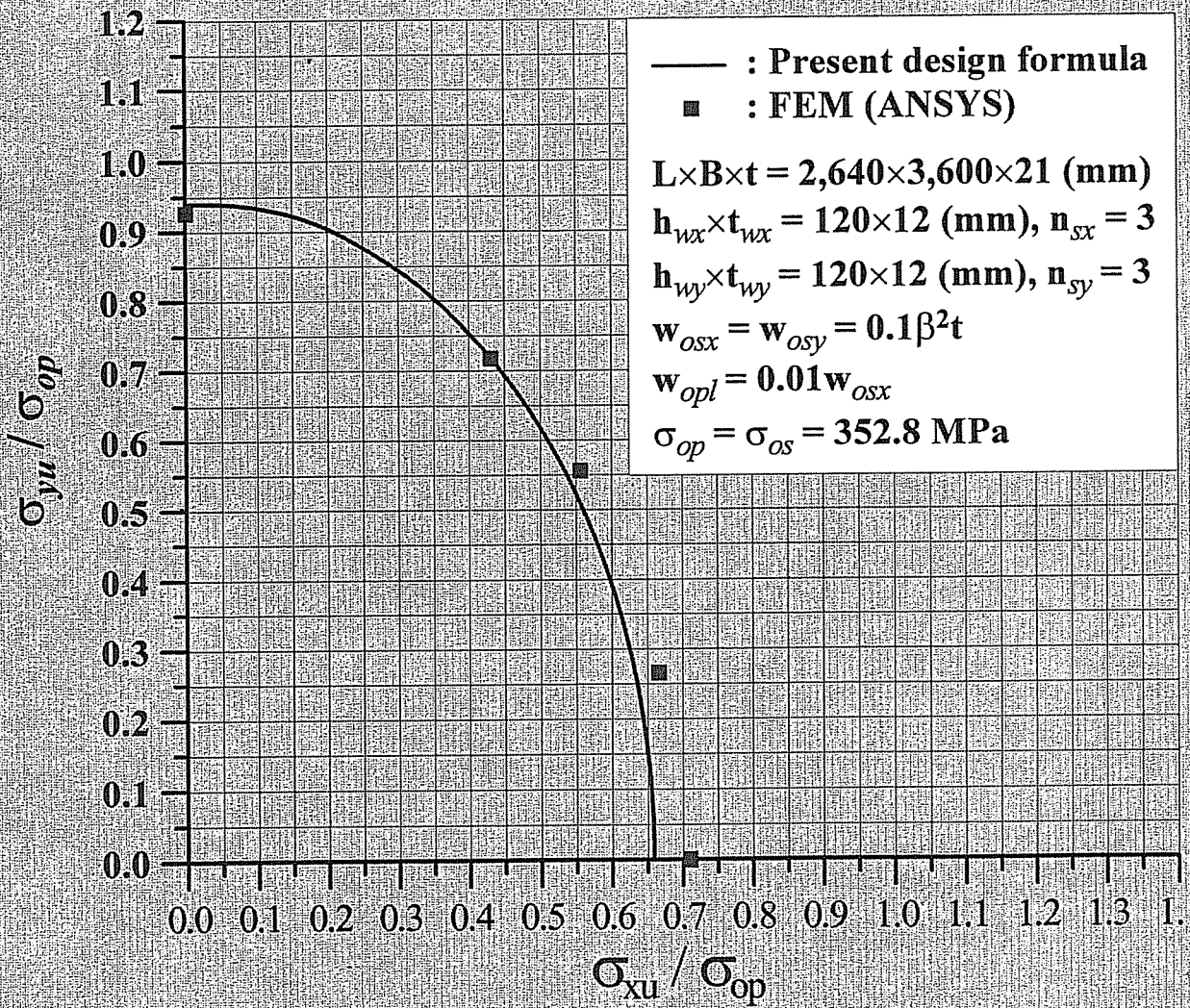
Uniaxially Stiffened Panel in Combined Axial Compression and Edge Shear

Verification Examples



Uniaxally Stiffened Panel in Longitudinal Compression and Transverse Tension

Verification Examples



Orthogonally Stiffened Panel in Biaxial Compression