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ITHA-BRIDGE

SOFTWARE FOR INEASTIC TIME HISTORY ANALYSYS OF BRIDGES
PRE-PROCESSOR AND POST-PROCESOR OF OPENSEES

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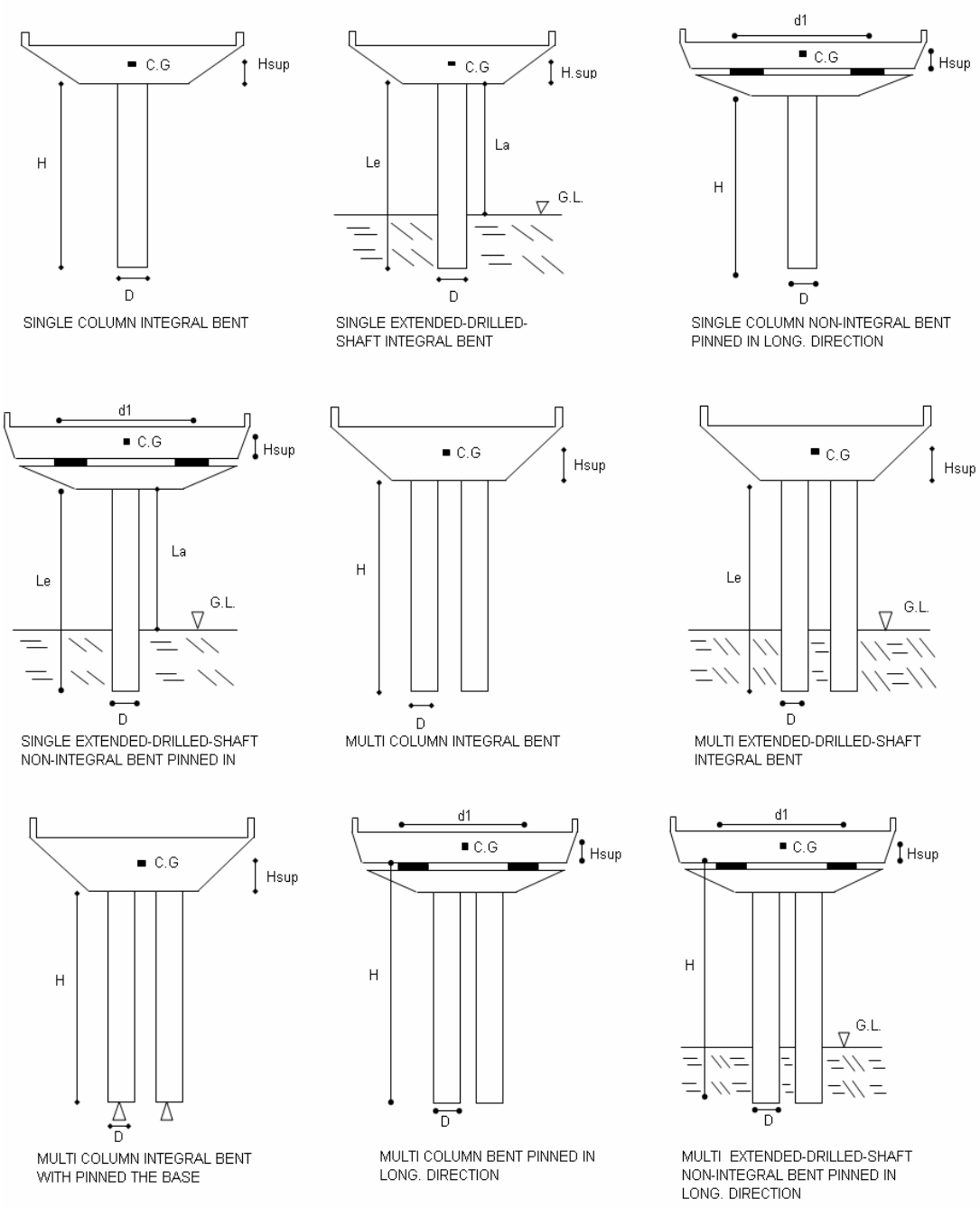
INTRODUCTION

The program ITHA-Bridge has been developed to perform Inelastic Time History Analysis (ITHA) of highway bridges. This program is a pre-processor and post-processor of OpenSees and has the following features:

- From a basic input automatically generates the bridge model files for OpenSees.
- Supports the substructures shown in Figure 1, integral and seat-type abutments. Also supports superstructure joints and plan curvature.
- Multiple acceleration records can be run in batch mode automatically.
- Checks convergence errors in solution and adjusts the analysis time step if necessary to achieve convergence.
- Produces and output file combining the output of the different acceleration records that were run.

ITHA-Bridge and its documentation can be accessed and used on-line though the Virtual Laboratory for Earthquake Engineering (VLEE) at www.utpl.edu.ec/vlee. The VLEE provides an interactive user interface for ITHA-Bridge and other related programs such as DDBD-Bridge.

Figure 1. Pier configurations supported by DDBD Bridge



RUNNING DDBD-BRIDGE

To run the program the user must input the data requested in the web interface and run the program on-line. Then, the user will receive an email with the report of the simulation.

INPUT DATA

When using the web interface, the user inputs a number of design variables. These parameters are defined next.

Bridge Configuration

NSPAN	Number of spans **[1-8]**
SLENGTH	Total length of the superstructure (m) **[> 0]**
SANGLE	Subtended angle that gives plan curvature (deg) **[> 0]**

Superstructure

SW	Weight of the superstructure (kN/m) **[>0]**
SH	Distance from the centroid to the bottom of the superstructure section (m) [>0]
IZ	Out-of-plane inertia of the superstructure section (m4)
IY	In-plane inertia of the superstructure section (m4)
EC	Elastic modulus of the superstructure (MPa)
A	Area of the superstructure section (m2)
J	Torsion constant of superstructure (m3)
NPS	Number of frame elements each span is divided in
NEJ	Number of expansion joints in the superstructure

Earthquake records

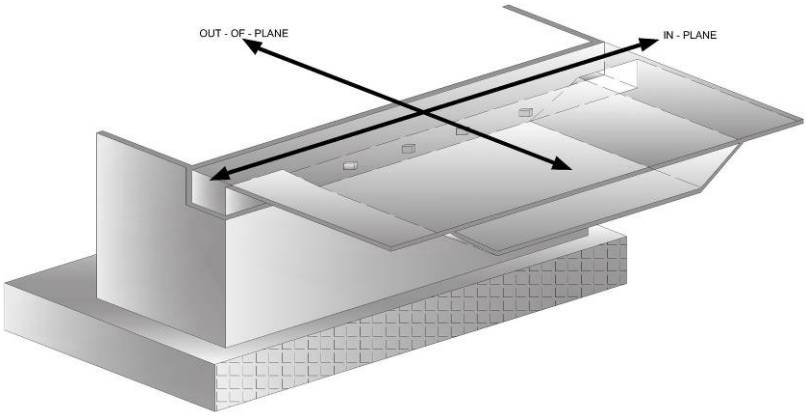
NEQ	Number of acceleration records to be applied
TOL	Tolerance in the ITHA solution (0.0001 - 0.000001)
PDELTA	0 to turn off P-Delta effects in the analysis 1 to turn on P-Delta effects in the analysis
ACCX	Name of the file that has the acceleration record to be applied in the X direction
ACCY	Name of the file that has the acceleration record to be applied in the Y direction
DUR	Duration of the record (s)
DT	Time step of the record (s)
FX	Factor applied to the record in the X direction
FY	Factor applied to the record in the Y direction

Material Properties

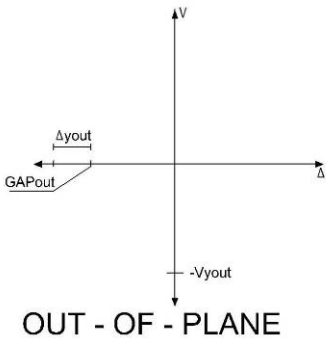
WC	Unit weight of concrete (kN/m^3) [>0]
FPC	Specified unconfined compressive strength of concrete (MPa) [>0]
FY	Specified yield stress of longitudinal reinforcement bars (MPa) [>0]
FUR	Ratio between ultimate and yield stress of longitudinal reinforcement bars [>1]
ESU	**S**train at maximum stress of longitudinal reinforcement bars [0.06-0.12]
FYH	Specified yield stress of transverse reinforcement bars (MPa) [>0]
FURH	Ratio between ultimate and yield stress of transverse reinforcement bars [>1]
ESUH	**S**train at maximum stress of transverse reinforcement bars [0.06-0.12]

Substructure Types

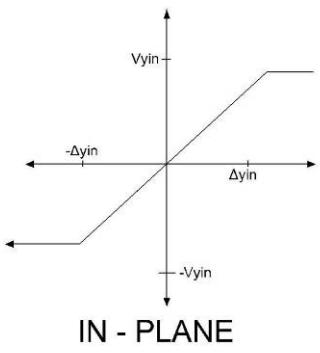
Abutment



STA	Distance from the left end of the bridge to the element (m) [0 or SLENGTH]
SKEW	Skew angle (Degrees measured from axis perpendicular to bridge) [0 a 90]
DYOUT	Out-of-plane yield displacement (m)
DYIN	In-Plane yield displacement (m)
VYOUT	Out-of-plane yield force of the abutment (kN)
VYIN	In-plane yield force of the abutment (kN)
GAPOUT	Expansion gap in the longitudinal direction of the abutment
DAMP	Viscous damping (%) [5%-10%]
W	Weight of the abutment (kN**)** [>=0]

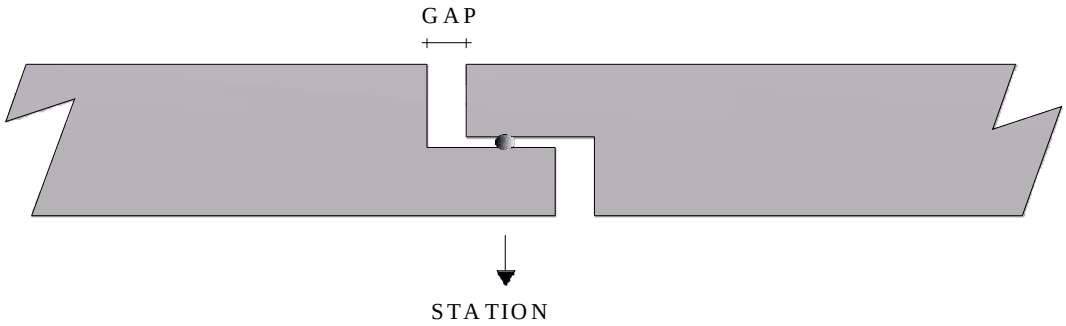


OUT - OF - PLANE



IN - PLANE

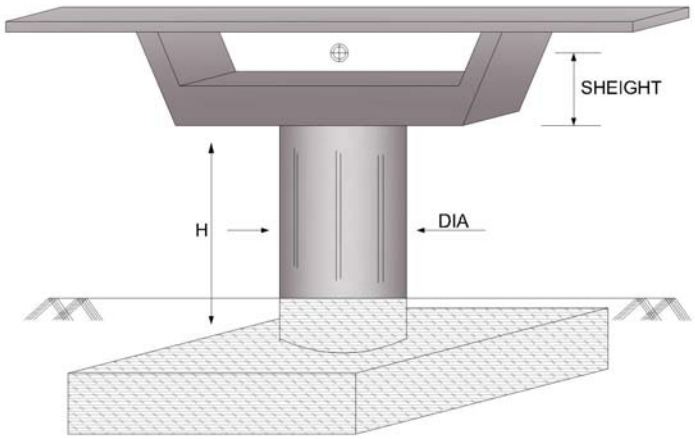
Expansion Joint



STA Distance from the left end of the bridge to the element (m) [0-SLENGTH]

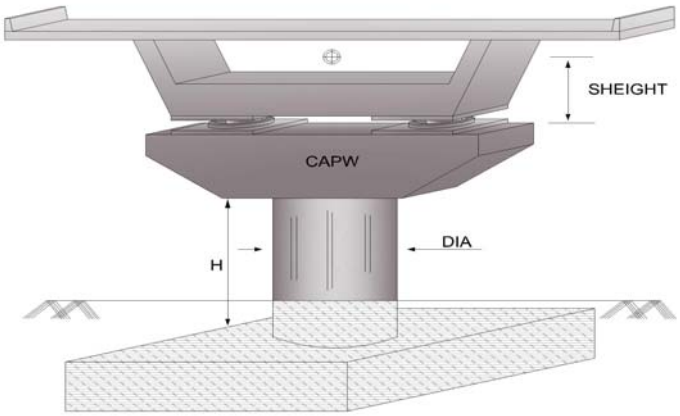
GAP Size of the expansion gap (m) [>=0]

Single column integral bent



STA	Distance from the left end of the bridge to the element (m) [0-SLENGTH]
DIA	Diameter of the column (m) [>0]
H	Clear height of the column (m) [>0]
NLBAR	Number of longitudinal bars
DLBAR	Diameter of the longitudinal bars (m) [>0]
DHBAR	Diameter of the transverse reinforcement (mm) [>0]
HBARS	Spacing of the transverse reinforcement (mm)
COV	Concrete cover to the transverse reinforcement (mm)
NPC	Number of elements in which the column is divided [1 – 5]
CBW	Weight of the Capbeam (kN)

Single column bent



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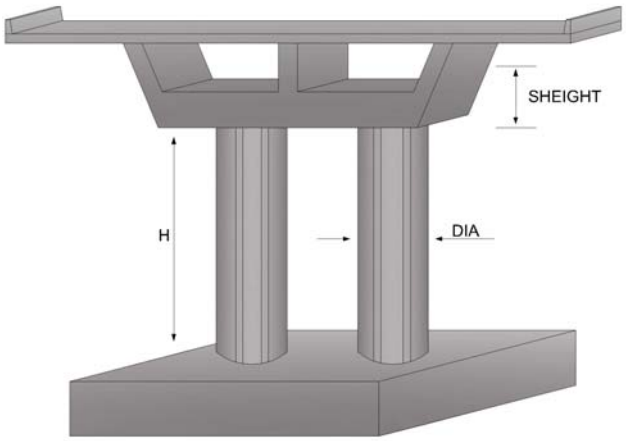
SKEW	Skew angle [0-90]

Multi column integral bent



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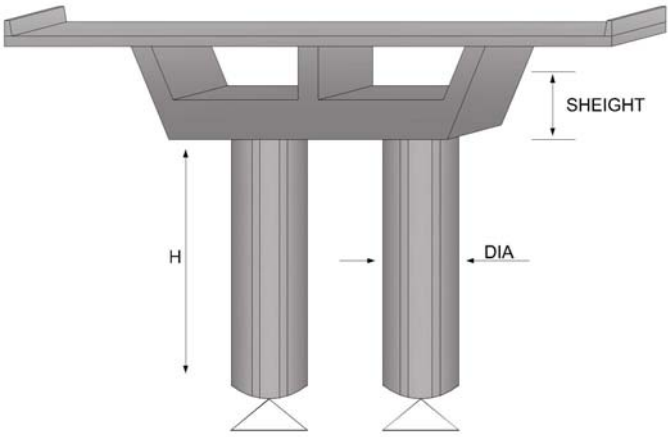
DLBAR	Diameter of the longitudinal bars (m) [>0]
DHBAR	Diameter of the transverse reinforcement (mm) [>0]
HBARS	Spacing of the transverse reinforcement (mm)
COV	Concrete cover to the transverse reinforcement (mm)
NPC	Number of elements in which the column is divided [1 – 5]
NCOLS	Number of columns in the bent
SCOL	Spacing of the columns
CBW	Weight of the Capbeam (kN)

Multicolumn integral bent with pinned base



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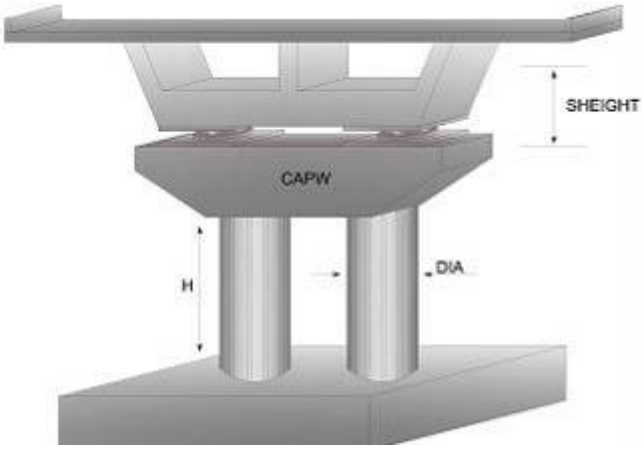
Multicolumn bent



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COV	Concrete cover to the transverse reinforcement (mm)
NPC	Number of elements in which the column is divided (1 – 5)
NCOLS	Number of columns in the bent
SCOL	Spacing of the columns
CBW	Weight of the Capbeam (kN)
SKEW	Skew angle[0-90]
CAPH	Height of the capbeam (m)