

# AStrutTie 2017

## Strut-and-Tie Model Analysis/Design of Structural Concrete

AStrutTie is a strut-tie model analysis/design software for concrete members with disturbed stress region(s).

It enables users to design corbel (bracket), abutment/pier footing, bridge pier coping (pier cap), frame corner, anchorage zone, deep beam, etc. The software supports U.S (ACI, AASHTO) and Europe (EuroCode 2) Codes and Specifications.

### Why Strut-Tie Model?

A concrete member can be classified into B-region(s) and D-region(s). D-regions are parts of structure in which the strain distribution is highly nonlinear. Most design practices for D-regions are mostly based on empirical approaches. The strut-tie model approach promotes a better understanding of load transfer mechanisms and structural behavior and it improves the designers' ability to handle unusual circumstances including D-regions.

### Optimum Solution for Strut-Tie Model Approach

AStrutTie is a powerful and practical analysis/design software for concrete members with D-region(s). The most appropriate strut-tie models can be constructed by considering the principal stress flows and/or evolutionary structural optimization (ESO) results. A specialized solver capable of handling any types of internally/externally (in)determinate strut-tie models is associated. The strut-tie model provisions of ACI 318-14 (2014), AASHTO LRFD (2014), and EC2 (2004) are applied.

### Efficient Structural Modelings for Strut-Tie Model Design

For fast and efficient strut-tie model designs, multirole templates are provided for corbel (bracket), abutment footing, pier footing, bridge pier coping (pier cap), frame corner, anchorage zones with inclined and straight tendons, deep beams with concentrated and distributed loads interior/exterior beam-column joint, and PSC box. The shapes of concrete members and truss models can also be generated by importing .dxf files. Advanced element sets representing truss mechanism, truss and arch mechanism, and fan action are provided.

### Systems for Automated Design Checks and Structural Design Report

AStrutTie provides various automated design checks regarding the conditions for rebar requirement and strength verification of struts and nodal zones. Visual verifications of strength conditions are possible, too. A structural design report is generated automatically, and design results are examined by previewing the report. The structural design report is printed as a \*.rtf, \*.xlsx, and \*.pdf file.

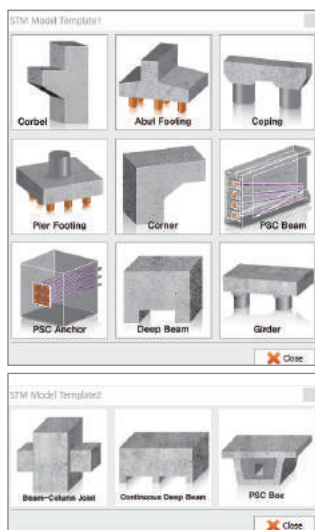
### Problems in Strut-Tie Model Analysis/Design of Structural Concrete

- Uncertainty in the construction of an appropriate strut-tie model due to lack of general and comprehensive specifications
- Inefficiency in the construction of strut-tie models representing load transfer mechanisms for multiple load combinations
- Enormous time and efforts for examining the suitability of a constructed strut-tie model that satisfies the strength conditions of struts and nodes

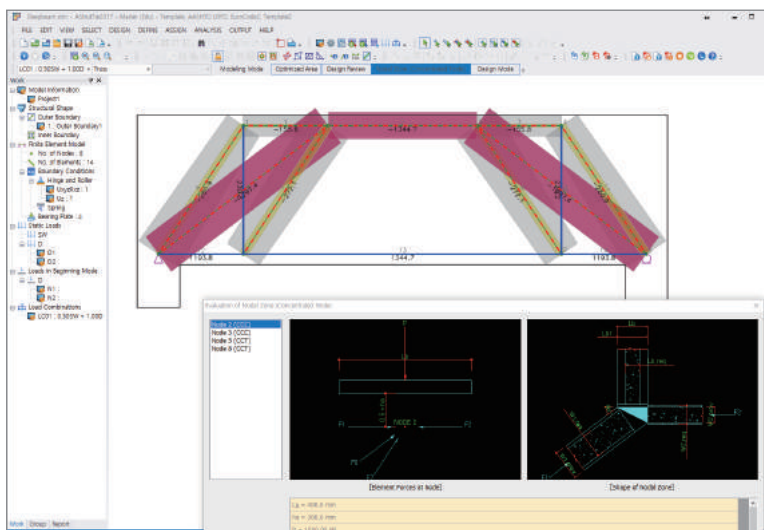
### Need Strut-Tie Model Analysis or Design? How about using AStrutTie?

The strut-tie model approach has been recognized as an efficient methodology for the design of all types of structural concretes with D-regions, and accepted in design codes globally. However, the design of a structural concrete with the approach requires many iterative numerical structural analyses, numerous graphical calculations, enormous time and efforts, and designer's subjective decisions in terms of the construction of an appropriate strut-tie model, determination of required areas of struts and ties, and verification of strength conditions of struts and nodal zones.

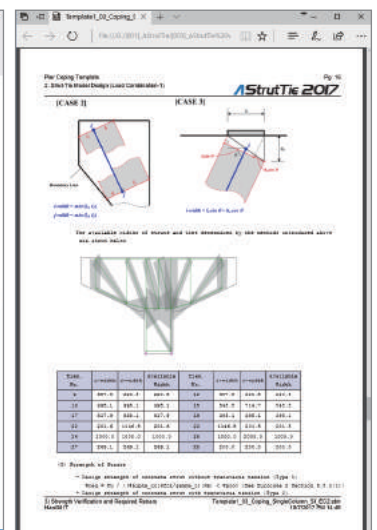
HanGil has developed a design software AStrutTie that enables the analysis and design of structural concretes efficiently and professionally by overcoming the aforementioned limitations of the strut-tie model approach. In the software, all the numerical programs that are essential in the strut-tie model analysis or design of a structural concrete, including finite element analysis programs for the plane truss and solid problems with all kinds of boundary conditions, a program for evaluating the axial rigidities of struts and ties of statically determinate and indeterminate strut-tie models, a program for determining, and a program for the graphical verification of strut-tie model's appropriateness by displaying various geometrical shapes of struts and nodal zones, are loaded. Great efficiency and convenience during the application of the strut-tie model approach may be provided by the various graphics environment-based functions of the software.



Templates (Corbel, Footing, Pier Cap, Corner, PSC, Joint, etc)



Calculation of Available and Required Area of Struts and Nodal Zones



Structural Design Report (PDF File)

## Features of AStrutTie

### Ease of Use

- Intelligent graphical user interfaces
- Visualizations by using view option windows
- U.S customary and Metric (SI) units
- Tabular and dialog inputs
- 2-D on-screen graphics
- Graphical display of applied loads, boundary conditions, and structural analysis results
- Visual and tabular verifications of strength conditions of struts and nodes
- 12 templates for typical D-regions and structural members
- Design checks on user interfaces
- Preview of structural design report
- Report output as Word (\*.rtf), Excel (\*.xlsx), and PDF (\*.pdf) file
- Importation of \*.dxf file for modeling of solid and truss structures
- Verified (in)determinate strut-tie models for templates
- Unconstrained solid and truss modelings for strut-tie model design

### Convenient Editing Tools for Truss Structure

- Versatile Editing Tools supplied by the Nine Templates
- User-based General Editing Tools (cut, copy, paste, delete, find, divide, offset, move, stretch, mirror, rotate)
- Object Osnap (End, Mid, Cross, Near, Perpendicular Point)
- Guidelines and Grid Points
- STM Constructed from Boundary Lines of Concrete Member
- Automatic Check of Object Overlaps
- Modeling of Structures by Dxf Import/Export

### Functions of Truss Solver

- Analysis of Internally/Externally Determinate/Indeterminate Truss Structures
- Inclined, Horizontal, and Vertical Restraints by Spring, Hinge, and Roller
- Determination of Required Areas and Forces of Struts and Ties by Iterative Technique
- Safety Evaluation of Existing Structural Members by Assigning Steel Tie Areas
- Calculation of Available Areas of Struts and Ties
- Determination of Average Principal Tensile Strain of Reinforcing Bars crossing Perpendicularly to Concrete Strut by Iterative Technique
- Automatic Transformation of Distributed Forces to Nodal Forces

### Functions of Plane Solid Solver

- Analysis of Plane Stress and Plane Strain Problems
- Inclined, Horizontal, and Vertical Restraints by Spring, Hinge, and Roller
- Optimized Mesh Generator according to Concrete Member Shape
- Automatic Transformation of Distributed Forces to Nodal Forces
- Calculation of Principal Stresses and Directions
- Relative Lengths and Colors of Principal Stresses along Principal Directions
- Implementation of Evolutionary Structural Optimization Technique

### Included Design Codes

- AASHTO LRFD (2014)
- ACI 318-14 (2014)
- EC 2 (2004)

### Items for Design Checks

- Strength Verification of Concrete Struts
- Required Areas of Steel Ties
- Strength Verification of Nodal Zones
- Minimum Reinforcement Ratio for Serviceability

### Support Items of Templates

#### Corbel (Bracket)

- Automatic Determination of Location of STM Node subjected to Applied Loads
- Two Types of Strut-Tie Models according to Shear Span-to-Effective Depth Ratio (Direct, Direct & Horizontal Truss)

#### Abutment/Pier Footing

- Spread and Pile Footings bounded by Springs
- Automatic Conversion of Applied Loads to Pile Reactions
- Automatic Assignment of Soil/Pile Reactions to Spring Constants
- Automatic Construction of STM according to Pile Locations and Number of Pile
- Automatic Determination of Pile Locations by Inputting Number of Pile

#### Bridge Pier Coping (pier cap)

- Automatic Construction of STM by Selecting Load Transfer Mechanism (Arch, Vertical Truss)
- Automatic Construction of STM according to Number of Concentrated Load Point

#### Frame Corner

- Four Separate Templates according to Moment Types and Corner Shapes
- Four Basic Types of STM recommended by EC2

#### Anchorage Zone

- Automatic Construction of STM considering AASHTO LRFD's Bursting Force Location
- Tendon Layout, and Number of Anchor Plate
- Automatic Construction of STM according to Eccentric Distance

#### Simply Supported Deep Beam & Two-Span Continuous Deep Beam with Concentrated Loads

- Three Types of FIB STM according to Shear Span-to-Effective Depth Ratio (Arch, Vertical Truss, Combined)
- Automatic Construction of STM according to Number of Load Point, Symmetric/Asymmetric Load, and Symmetric /Asymmetric Geometrical Shape

#### Continuous Beams with Distributed Loads

- Automatic Construction of STM resulting in Vertical and Horizontal Reinforcing Bars
- STM for Continuous Deep Beams

#### Beam-Column Joint

- Two Separate Templates according to Joint Shape (Interior & Exterior Joints)
- Automatic Construction of STM according to Direction of Moments

#### Diaphragm in PSC Box Girder

- Two Separate Templates according to Shape of Diaphragm (Solid & Hollow Types)
- Automatic Construction of STM according to Location of Bearing Plates and Direction of Torsion

## System Requirements

### Software

Microsoft Word2007 or higher  
Microsoft Excel2007 or higher

### Network

When you activate AStrutTie, please must keep online internet. If you use firewall, please add it to your firewall.

- activation.aroadd.co.kr
- service.aroadd.co.kr
- www.aroadd.co.kr

### Processor

1GHz 32bit(x86) or higher

### Memory

1GB recommended

### VGA

NVIDIA Geforce 8600 GT 512MB or higher  
AMD Radeon HD 4350 512MB or higher

### Disk Space

300 MB

### Input Device

Mouse, Keyboard

### Operating System

Microsoft Window7(32, 64bit)  
English Version

### Precautions

1. Need Installation of Microsoft Excel for \*.xlsx File Output
2. Need Internet Online for Activation of AStrutTie
3. Certify Perfect Activation of AStrutTie in Microsoft Window7 for English (32, 64bit - Some of AStrutTie functions may not work well on other Operating System.)

## Find out about AStrutTie

### Homepage

<http://AStrutTie.aroadd.co.kr>

### Youtube

Please search  
AStrutTie on YouTube.

### Email

[astruttie@aroadd.co.kr](mailto:astruttie@aroadd.co.kr)

### HanGil IT Homepage

<http://www.aroadd.co.kr/english/>