Safety Tools for Intersection Control Evaluation (ICE)

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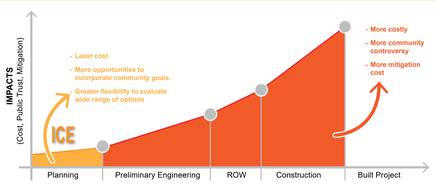
Introduction to ICE

What is ICE?

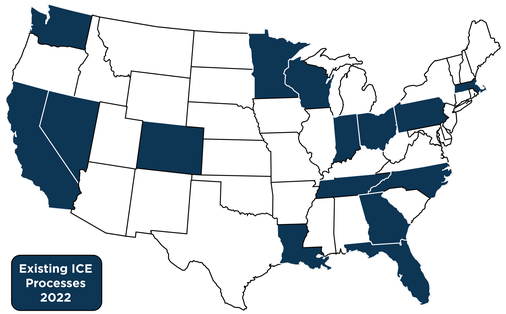
- **A process** that provides the framework, steps, tools, and decision-support for assessing trade-offs between different intersection forms and controls.
- In many states, ICE is also **a policy** that establishes the general applicability and legal underpinnings for the process.

When to Apply ICE?



Goals of ICE

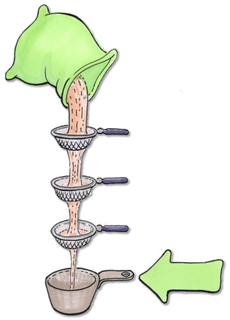
1. **Set expectations** of when and how intersection evaluations are to be conducted for better project decision-making.
2. **Establish documentation** so that intersection studies, analyses, recommendations, and project programming decisions are transparent.
3. **Increase awareness** of innovative intersections and roundabouts.



NCHRP Project 17-98/Report 1087 Overview

Objective was to develop a guide for intersection control evaluation (including processes and tools). For the purpose of this research, “intersection” includes interchanges.

- ICE Process Tool
- Capacity Analysis for Planning of Junctions (CAP-X) Tool
- Planning and Preliminary Engineering Applications Guide (PPEAG) ICE Tool
- Equity Assessment Tool
- **20 Flags Calculator Tool**
- **Safe Systems for Intersections (SSI) Calculator**
- **Safety Performance for Intersection Control Evaluation (SPICE) Tool**
- Life-Cycle Cost Estimating Tool (LCCET)
- **Recommended Configurations for Pedestrians and Bicycles**



SSI Calculator

Origin: This project, using a 2021 FHWA method (FHWA-SA-21-008)

What it Does: Computes Safe System “score” of safety based on conflicts and severity

Basic Usage: Enter volume, lane configuration, and speed

How to Use in ICE: Stage 1 safety screening, analysis when SPF or CMF does not exist

Customization Capabilities: Any intersection form can be analyzed

Alternative	Exposure (Relative to Existing)			Average P (FSI)			Average Complexity			SSI Score	SSI Conflict Type Score		
	Crossing	Merging	Diverging	Crossing	Merging	Diverging	Crossing	Merging	Diverging		Crossing	Merging	Diverging
RAB1x1	1.00	1.27	1.42	0.00	0.00	0.00	0.27	0.27	1.00	**100**	100	100	100
RAB2x1	1.00	1.27	1.42	0.00	0.00	0.00	0.40	0.37	1.00	**100**	99	100	100
Trad_AllStop	1.00	1.00	1.00	0.01	0.00	0.00	5.31	1.43	1.00	**92**	78	99	100
MUT	0.57	2.22	2.95	0.08	0.02	0.01	1.77	1.07	1.00	**79**	69	79	92
RAB2x2	1.00	1.27	1.42	0.00	0.00	0.00	0.54	0.47	1.00	**100**	99	100	100
RCUT_Sig	0.21	2.54	3.33	0.16	0.02	0.02	1.77	0.96	1.00	**81**	77	76	91
Bowtie	1.28	1.66	2.00	0.08	0.01	0.01	3.55	2.10	1.00	**54**	18	90	97
QR	1.36	1.29	1.61	0.07	0.01	0.01	3.12	1.26	1.00	**49**	14	87	97
Jughandle	1.10	1.10	1.11	0.07	0.01	0.01	4.14	1.99	1.00	**52**	17	86	97
Trad_Sig	1.00	1.00	1.00	0.06	0.01	0.01	4.46	1.00	1.00	**51**	15	92	98
RCUT_Unsig	0.21	2.54	3.33	0.13	0.02	0.02	2.55	1.54	1.00	**77**	74	68	91
Trad_MinorStop	1.00	1.00	1.00	0.06	0.01	0.01	5.54	1.43	1.00	**42**	9	88	98
FDLT	0.92	1.00	1.00	0.08	0.01	0.01	2.40	2.15	1.00	**63**	31	83	98
PDLT	1.00	1.00	1.00	0.07	0.01	0.01	3.18	1.49	1.00	**60**	25	87	97

SPICE Tool

Origin: 2018 FHWA project (FHWA-SA-18-026)

What it Does: Crash prediction with safety performance functions (SPFs) and crash modification factors (CMFs)

Basic Usage: Enter AADTs and HSM variables for geometry and traffic control

How to Use in ICE: Data-driven safety analysis, benefit portion of B/C analysis

Customization Capabilities: SPF calibration factors, new CMFs

Safety Performance for Intersection Control Evaluation Tool

Results

Summary of crash prediction results for each alternative

Project Information

Project Name:	AASHTO Safety Summit Demo	**Intersection Type**	At-Grade Intersections
Intersection:	SR 1 at Main St	**Opening Year**	2025
Agency:	Anywhere DOT	**Design Year**	2045
Project Reference:	9999	**Facility Type**	On Urban and Suburban Arterial
City:	Houston	**Number of Legs**	4-leg
State:	Texas		
Date:	10/1/2024		
Analyst:	PMJ		

Crash Prediction Summary

Control Strategy	Crash Type	Opening Year	Design Year	Total Project Life Cycle	AADT Within Prediction Range?
2-lane Roundabout	Total	1.27	1.64	30.55	N/A
	Fatal & Injury	0.21	0.28	5.13	
Minor Road Stop	Total	1.57	2.02	37.72	No
	Fatal & Injury	0.66	0.87	16.03	
Traffic Signal	Total	2.85	3.88	70.53	Yes
	Fatal & Injury	0.99	1.36	24.60	
Displaced Left-Turn (DLT)	Total	2.51	3.41	62.07	N/A
	Fatal & Injury	0.87	1.20	21.65	
Median U-Turn (MUT)	Total	2.42	3.30	59.95	N/A
	Fatal & Injury	0.69	0.95	17.22	
Signalized RCUT	Total	2.42	3.30	59.95	N/A
	Fatal & Injury	0.77	1.06	19.19	
Jughandle	Total	2.11	2.87	52.19	N/A
	Fatal & Injury	0.73	1.01	18.21	

Recommended Configurations for Pedestrians and Bicycles

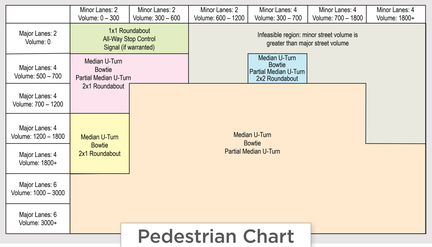
Origin: This project, using “20 Flags” method

What it Does: Indicate “best” intersection for a given AADT and lane #

Basic Usage: Read the chart

How to Use in ICE: Stage 1 screening

Customization Capabilities: Adjust thresholds or remove intersection types



Pedestrian Chart

20 Flags Calculator

Origin: NCHRP Report 948

What it Does: Identify undesirable/unsafe design features for pedestrians (by crossing) and bicycles (by approach)

Basic Usage: Enter details of intersection design

How to Use in ICE: Quantitative pedestrian and bicycle performance measure

Customization Capabilities: Adjust thresholds, weight or add/remove flags