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Data-centric Piping Support Design Automation (K-SUPPORT)

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About my company

KEPCO E&C - Global Plant Engineering Company

- founded in 1975 with the goal of accomplishing self-reliance in power plant engineering technology, in the midst of two times of oil crises in the 1970s.
- a world-class company having the A/E (Architect Engineering) and NSSS (Nuclear Steam Supply System) Design technology, and developed Korean standard nuclear power plant OPR1000 (Optimized Power Reactor 1000) and APR1400 (Advanced Power Reactor 1400), the next generation nuclear power plant with international competitiveness.
- In 2009, we participated in the bid to win a nuclear power plant project in UAE for the first exportation of Korean-model nuclear power plant
- Man Power : more than 2,300 employees, over 730 Master's Degree or PhD, more than 1,000 engineers



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Overview of K-SUPPORT

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1

Overview of K-SUPPORT

1. Background
2. Kick-off Development
3. Main Features of K-SUPPORT



▣ Piping Supports Design Work for NPP 1&2 Unit

Pipe Size	Q'ty of Support Tag	Q'ty of Design Drawing		Q'ty of Calc. book
		Single	Common	
Large Bore	32,000	10,000	1,700	1,300
Small Bore	89,000	-	-	-
Total	121,000	-	-	-

* The above numbers are approximate quantities and differs on design condition.

▣ Expansion of Nuclear Power Plant(NPP) market

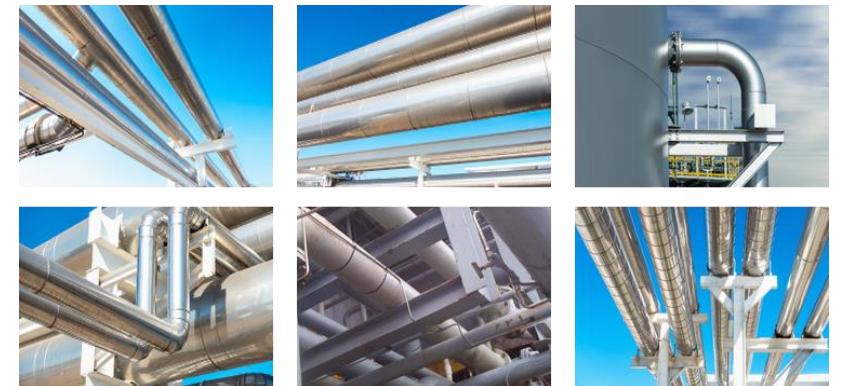
- ▶ Europe, Nuclear and gas in Green Taxonomy, Jul. 2022
- ▶ Korea Gov., Included NPP to K-Taxonomy in Aug. 2022
- ▶ War between Russia and Ukraine
 - ☞ **Shifting to NPP for energy security**
- ▶ iSMR and Nuclear-Hydrogen Technology Improvement

• Shop Fabricated Pipe Support



(Catalogue needed)

• Site Installed Frame Support



(Design Template needed)

1.2 Kick-off Development



K-SUPPORT

As a [data-centric piping support design software added in AVEVA E3D](#), it performs automated piping support 3D modeling and design drawings production fast and accurately.

Need

- Massive amount of supports design work
- Need to implement piping support [3D modeling quickly](#)
- Need to [produce](#) support design [drawing fast and accurately](#)
- Need to [produce support calculation](#) using data-centric model

Method

Collaborative Research and Development



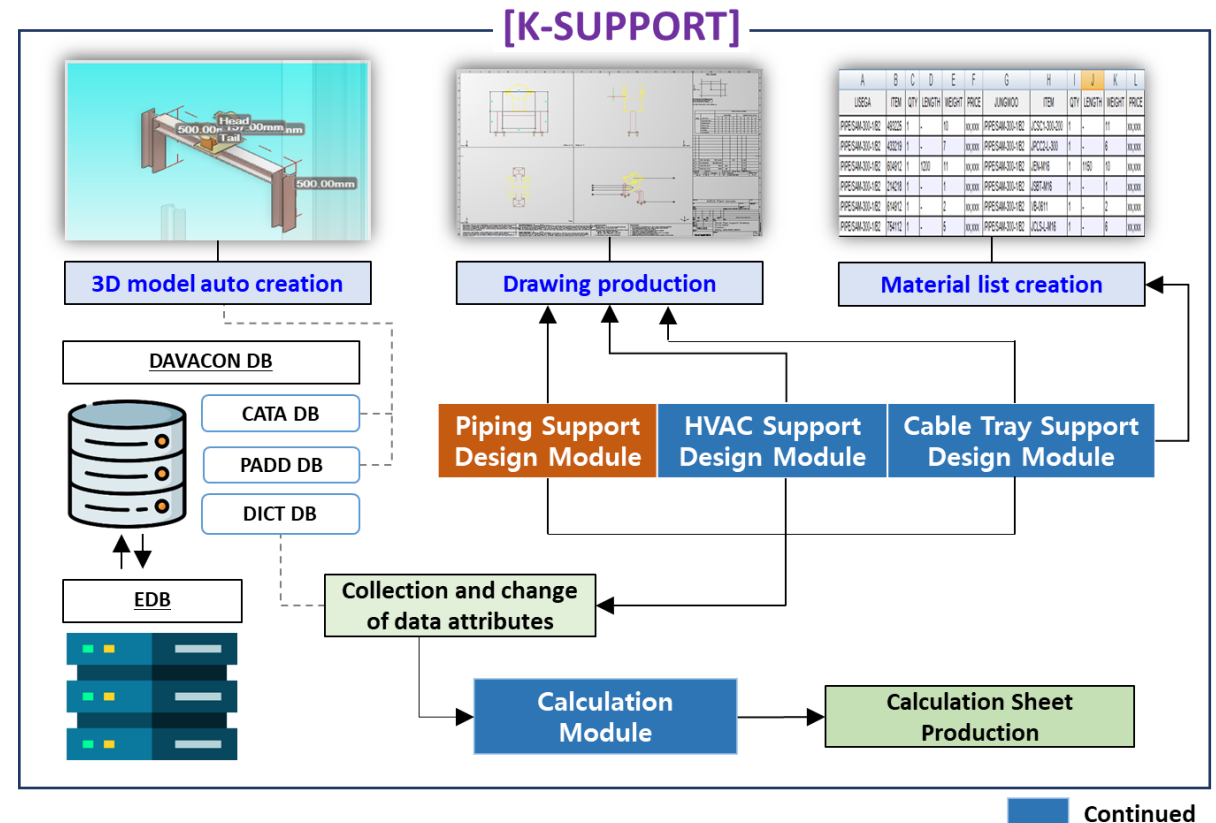
R&D Period

05.2021 ~ Continued (18 Months passed)

1.3 Main Features of K-SUPPORT

Features

- [Built-in 3D Catalogue of shop fabricated pipe supports](#) for main manufacturers
- [Modeling and design](#) of piping support [linked with piping model data](#)
- [Modeling and design](#) of piping support [using allowable design load data](#)
- Frame support and Shop fabricated pipe support modeling using [built-in templates](#)
- Automated [embedded plate modeling](#) on support
- [Batch change of modeling to third-party product](#)
- [Consistency check](#) between piping and support data
- [Automated 2D design drawing production](#)



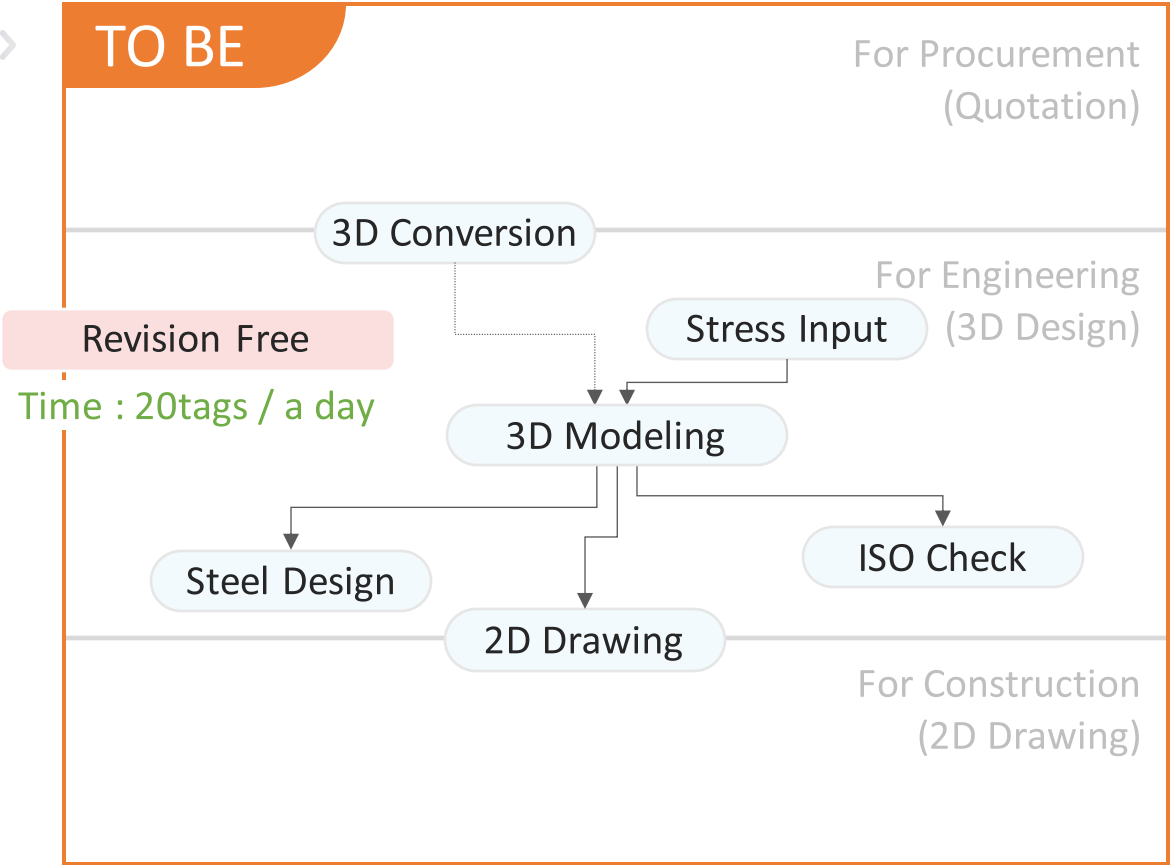
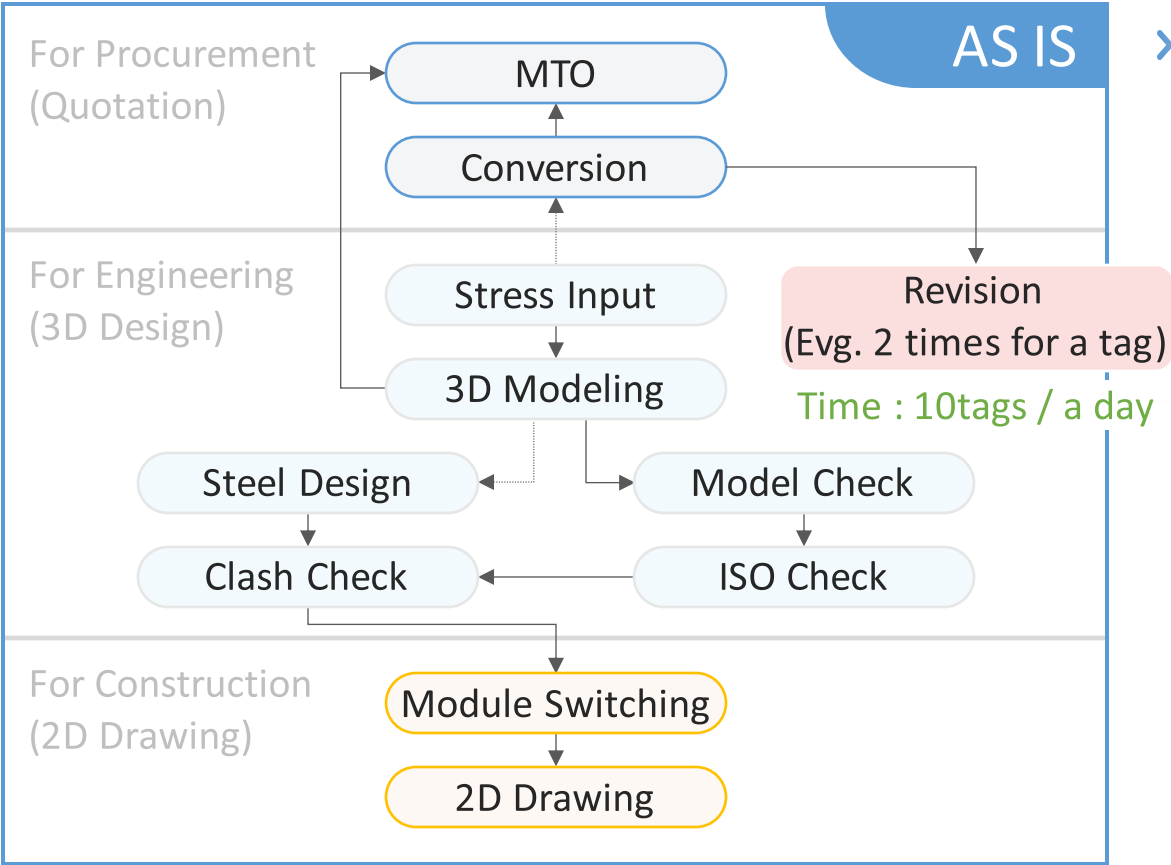
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Development Details of K-SUPPORT

1. Development necessity
2. User environment and performance
3. 3D model coverage and level
4. Automation function
5. Additional function



2.1 Development necessity



The cost “AS IS” estimated :
 $(T \times I + T \times R) \times TA = \underline{150,000 \text{ USD}}$

The cost “TO BE” estimated :
 $(T \times I) \times TT = \underline{45,000 \text{ USD}}$



about 70% Reduced

Tags(T)	: 1,000EA
Unit Price(I)	: 100 USD
Revision Price(R)	: 50 USD
The Rate of Time-Cost(TA)	: 100%
The Rate of Time-Cost(TT)	: 45%

2.1 Development necessity

Question ?

How can we reduce design time and cost for a numbers of points of pipe support?

How can we design on the same way for various type of pipe support offering each suppliers?

How can we optimize configurations of steel structure and do design in easy way?

How can we optimize to use of E3D for design of pipe support

Saving

- 70% of Engineering time for each point / more than 50% of Engineering cost
- 10 times faster than E3D Support for progressing
- Engineer's huge effort to understand for a plenty of catalogues from various suppliers
- Argument between engineering and procurement department
- Single GUI for any type of pipe hanger and support

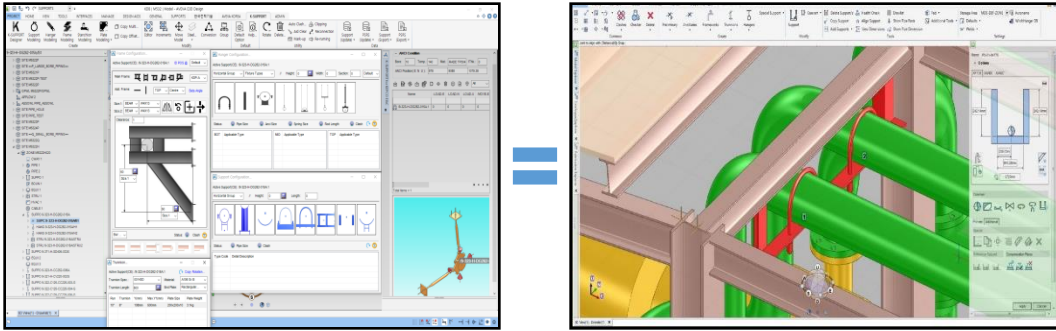
Benefit

Enjoy easy design including but not limited input, selection, 3D modeling, generation of 2D drawing, BOM and numbers of report with one single interface in E3D calling "**K-Support**"

2.1 Development necessity

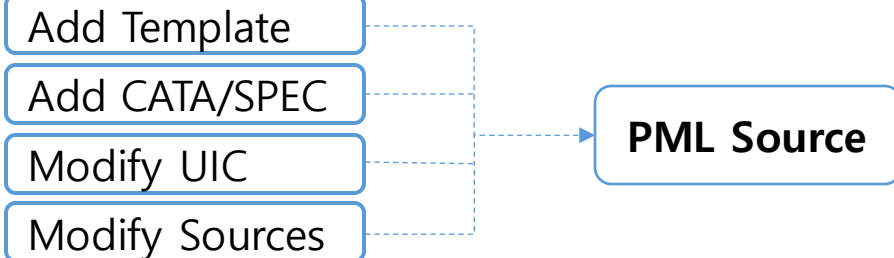
	E3D SUPPORT	Other 3 rd Party	K-SUPPORT
1 Selection of Assembly Configuration	Selected on MDS(1 st) Selected on External Interface(2 nd)	Selected on External Interface	Selected on Add-On Interface
2 Data Collection for Pipe Information	Manual Check of 3D Pipe Model Manual Input to External Interface	Required I/O Data File for Pipe Information	Automated Data Collection
3 Dimensioning	Automated Check from E3D Manual Input to External Interface	Manual Check from E3D Manual Input to External Interface	Automated Check/Input
4 Data Input of Pipe Stress	Manual Input to External Interface	Manual Input to External Interface	Automated Data Collection
5 3D Generation	Required I/O Data File for Model Data	Required I/O Data File for Model Data	Automated Model Generation
6 Revision	All Over Again	All Over Again	Simple Regeneration

2.2 User Environment and Performance



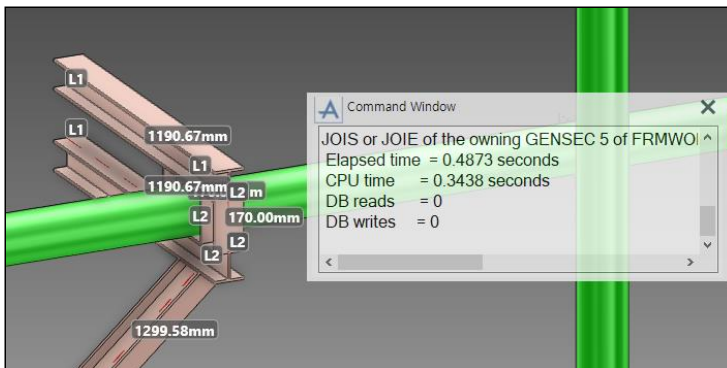
❖ Ribbon Bar

- User-executed commands using Ribbon bar
- Ribbon bar of the same shape as AVEVA E3D



❖ Convenience of adding new types

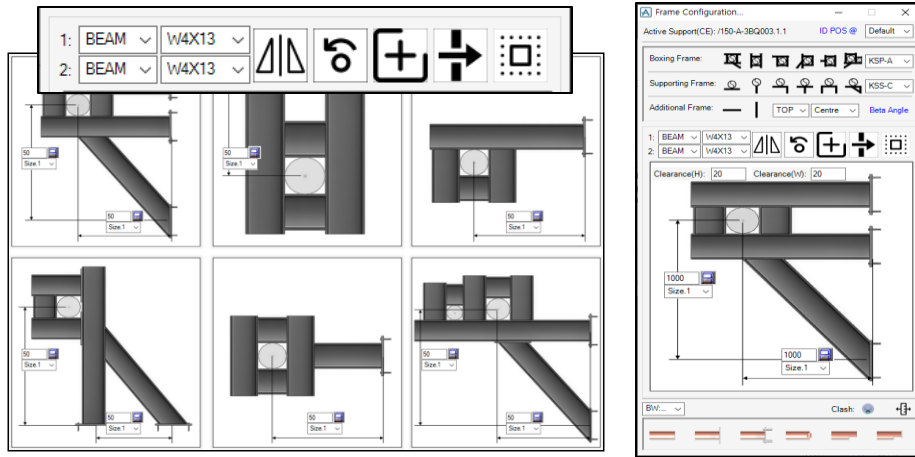
- New type can be added only by editing one PML Source



❖ Fast processing speed

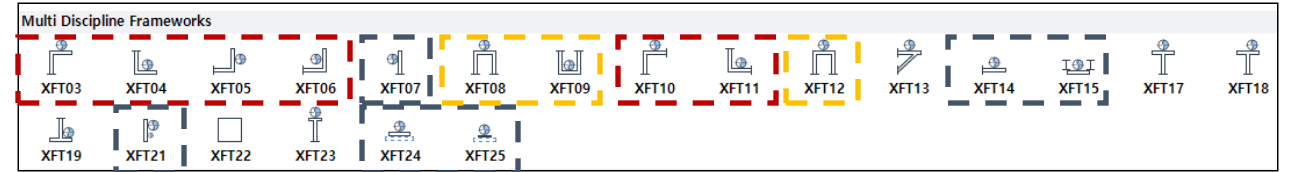
- Immediate processing by querying the model through PML Source
- K-SUPPORT < about 10 times < E3D SUPPORT

2.3 3D Model Coverage and Level



Direction

- Free to change the direction of the model
- Minimization of model type
- Type of K-SUPPORT = 10type of E3D SUPPORT

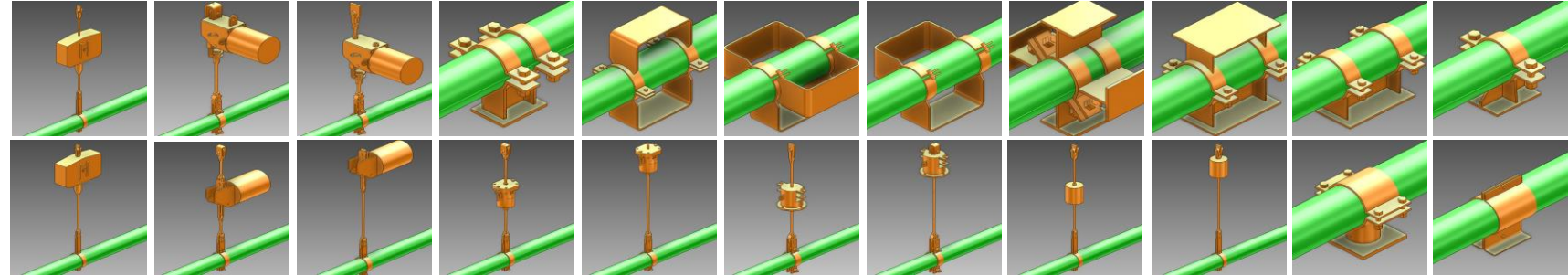


End Shape

- Apply end shape as user option
- Minimization of templates
- Improved program convenience.

Various model types

- Supports over 2,000 3D shapes



Bottom • Middle • Top

- Library selection
- Horizontal & Vertical
- Displacement Presence User Option
- Support type user option
- Part (bottom, middle, top) user options

✓ 1. Library selection

Default Options...

Support Creation Zone and Library

Support ZONE: /TESTZONE CE

Support Naming: A0LBA20BQ

Stress Units: IMPERIAL-lbf/inch

Hanger Library: Liseqa Support

Steel Library: Liseqa Support
UnisonHKR Support
Seonghwa Support

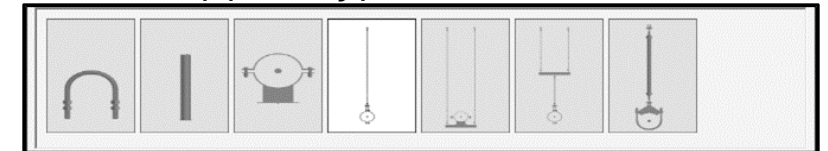
✓ 2. Horizontal, Vertical, Elbow

Hanger Configuration...

Support Number(Ref): /150-A-3BQ001.1

Horizontal Group Fixture Types // Height: 0 Width: 0 Section: 0 Default

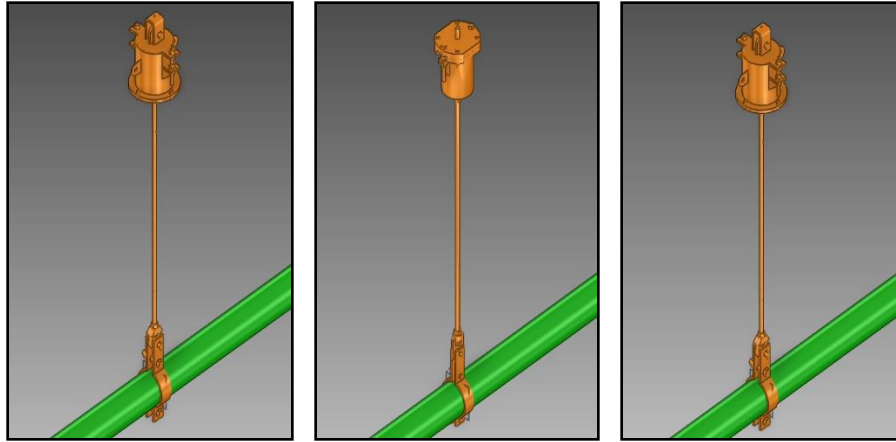
✓ 3. Support type selection



✓ 4. Bottom, Middle, Top detail

B1	JPC2: Double Bolt Pipe Clamp	M1	JSBT+JTBL: with Turnbuckle	T1	JLPT: Lug Plate
B1	JPC2: Double Bolt Pipe Clamp	M1	JSBT+JTBL: with Turnbuckle	T1	JLPT: Lug Plate
B2	JEL: Horizontal Lug Plate	M2	JSBT: without Turnbuckle	T2	JCLS: Clevis Attachment

2.3 3D Model Coverage and Level



LISEGA

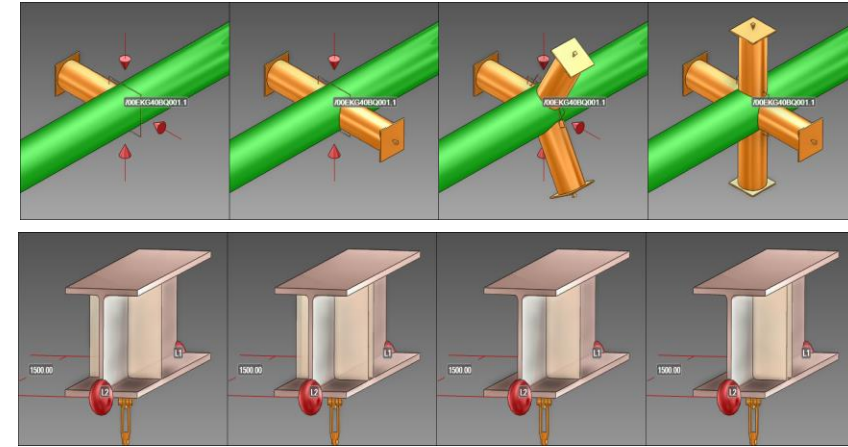
SEONGHWA

UNISON HKR



Multi Library Use

- LISEGA / SEONGHWA / UNISON HKR
- Standardization of products
- 3D Modeling & Drawing generation

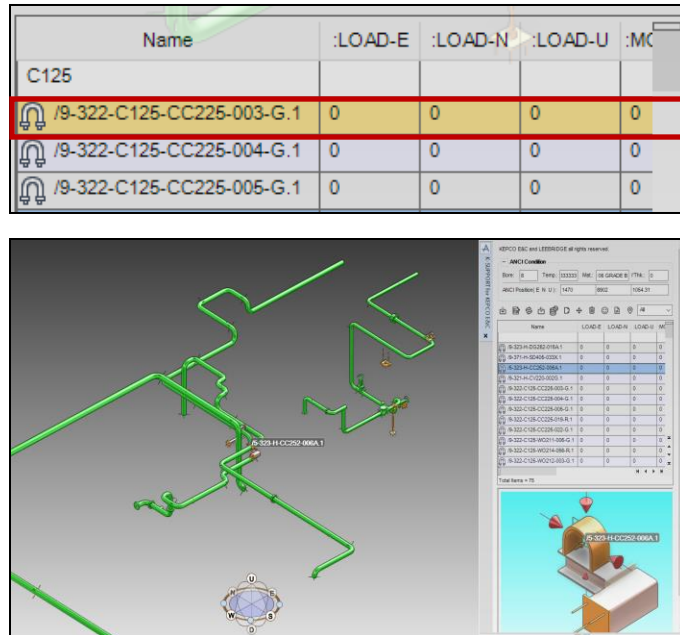


Stiffener / Anchor Pipe

- Attach Auxiliary to Model in Existing Tag
- No additional type
- No source code changes

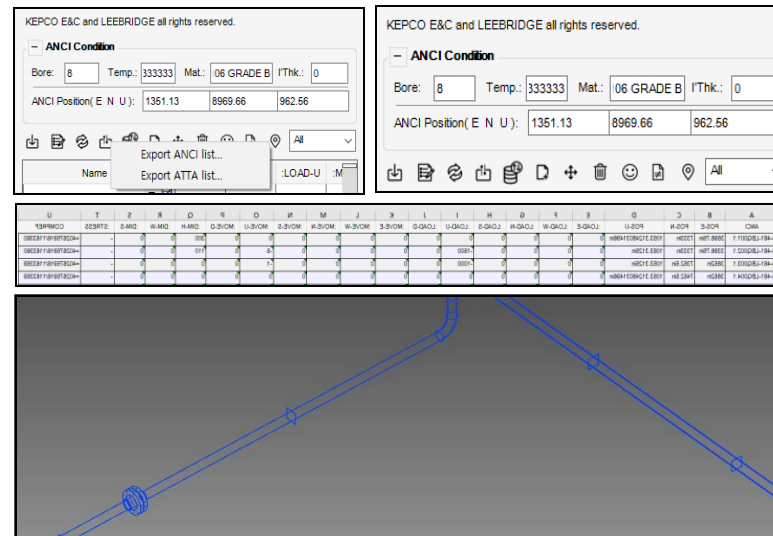
Model Navigating

- Check the position and navigate to the actual model



Logical Support

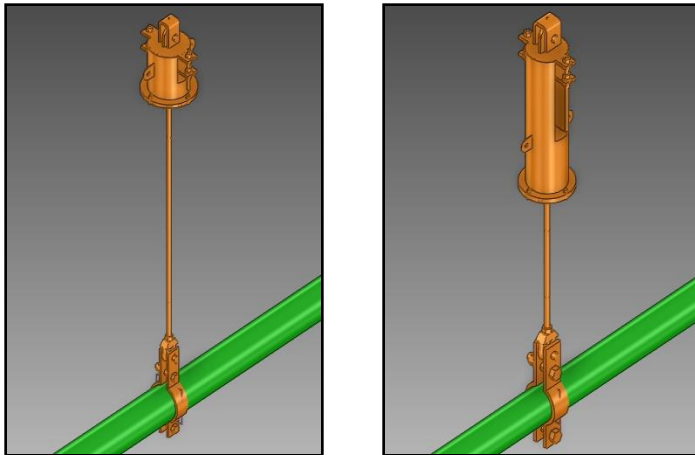
- Using Excel sheet-based data
- Automatic generation of logical points
- Logical Support Consistency Check
- Eliminate problems caused by constant data changes



2.4 Automation Function

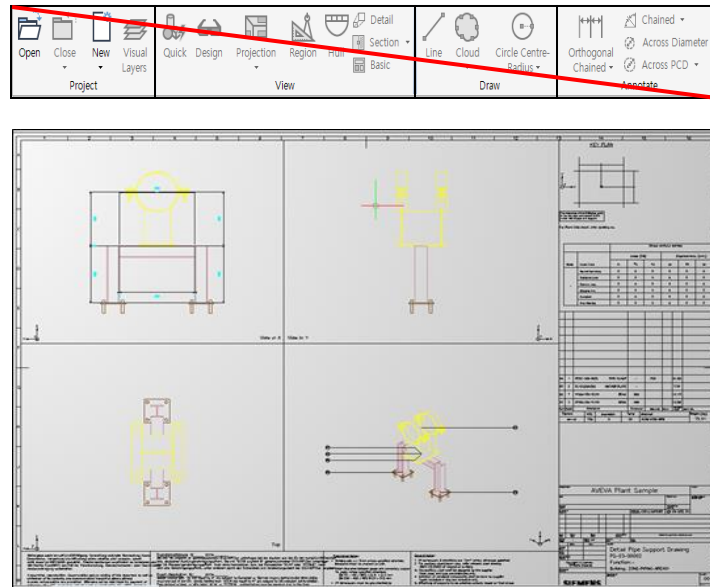
Support automatic selection

- Automatic selection of support size according to load/displacement
- Reduces the design work of the user



Automated Generation

- Batch drawing generation with collected information
- Simplification of the drawing process



Drawing automation

- No restrictions on the shape of the drawing template
- High visibility of drawings
- Generation drawings according to the shape of the model

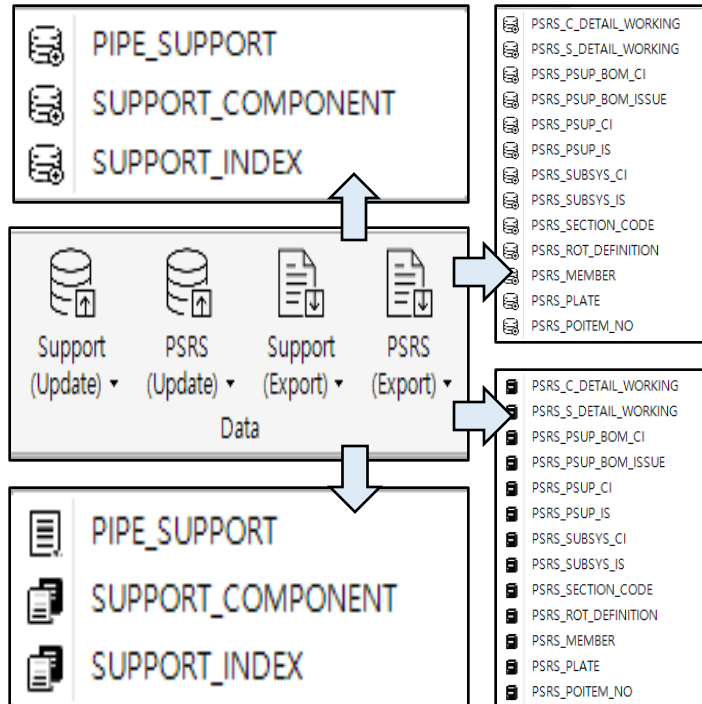


2.5 Additional Functions



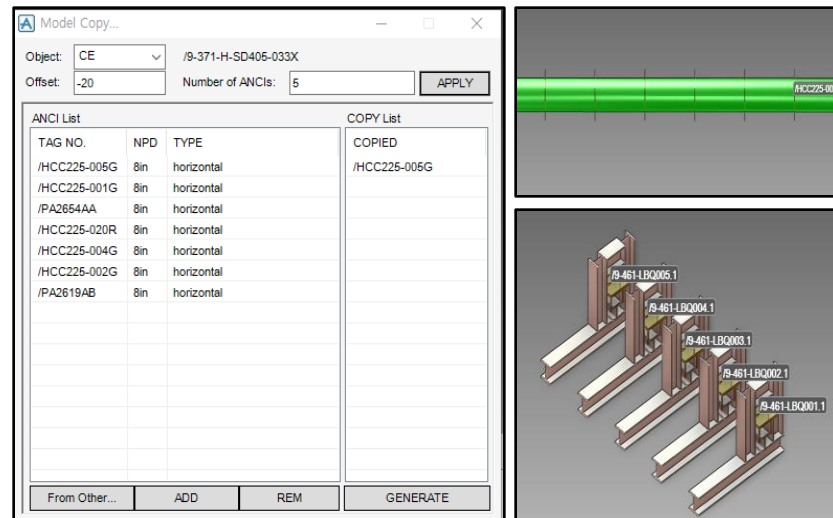
Database linkage between K-SUPPORT and KEPKO E&C

- K-SUPPORT design data -> KEPKO E&C data base update and Excel data generation



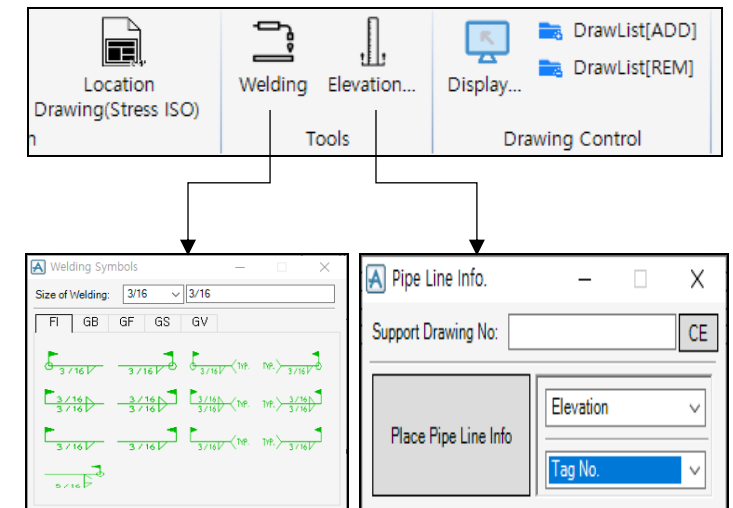
Copy Offset Multi Copy

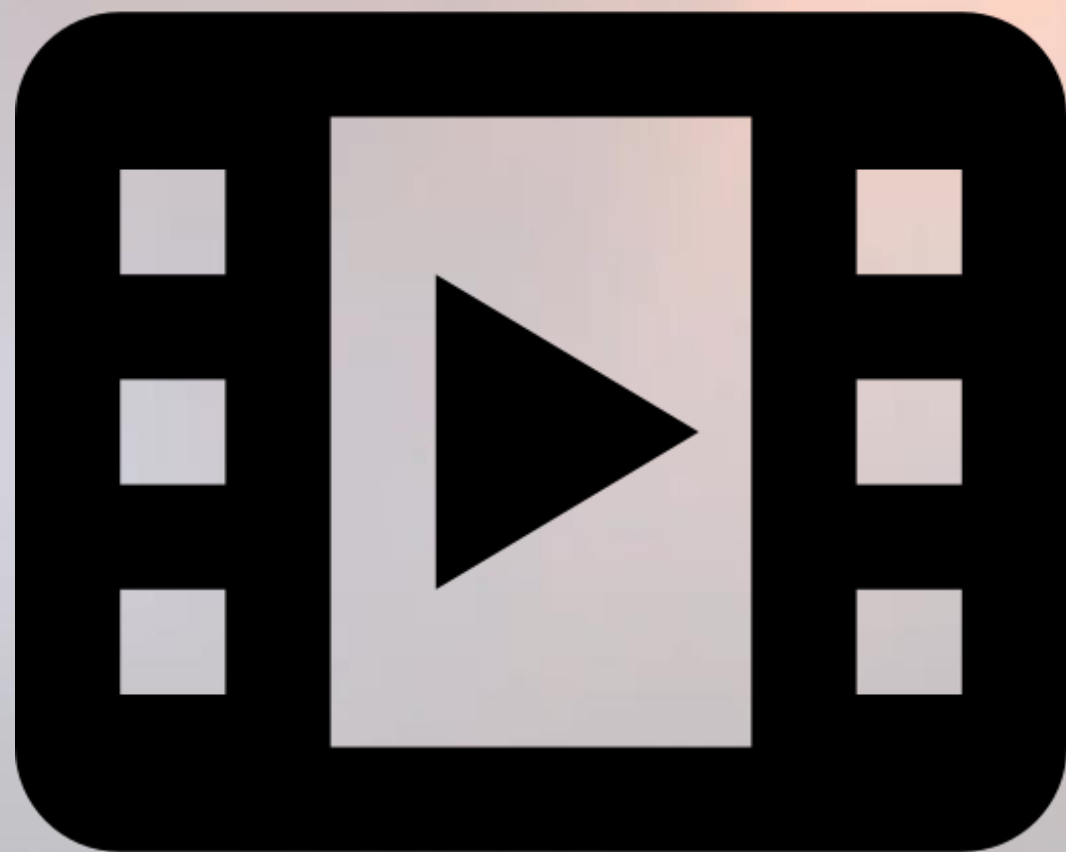
- Batch processing to copy support model in multi pipes
- Automated ANCI sizing, positioning & orientating according to the pipe properties



Weld/Elevation tagging and key plan application

- Automatic + semi-automatic program support for various symbols and location plans including Weld/Elevation





3 Conclusions



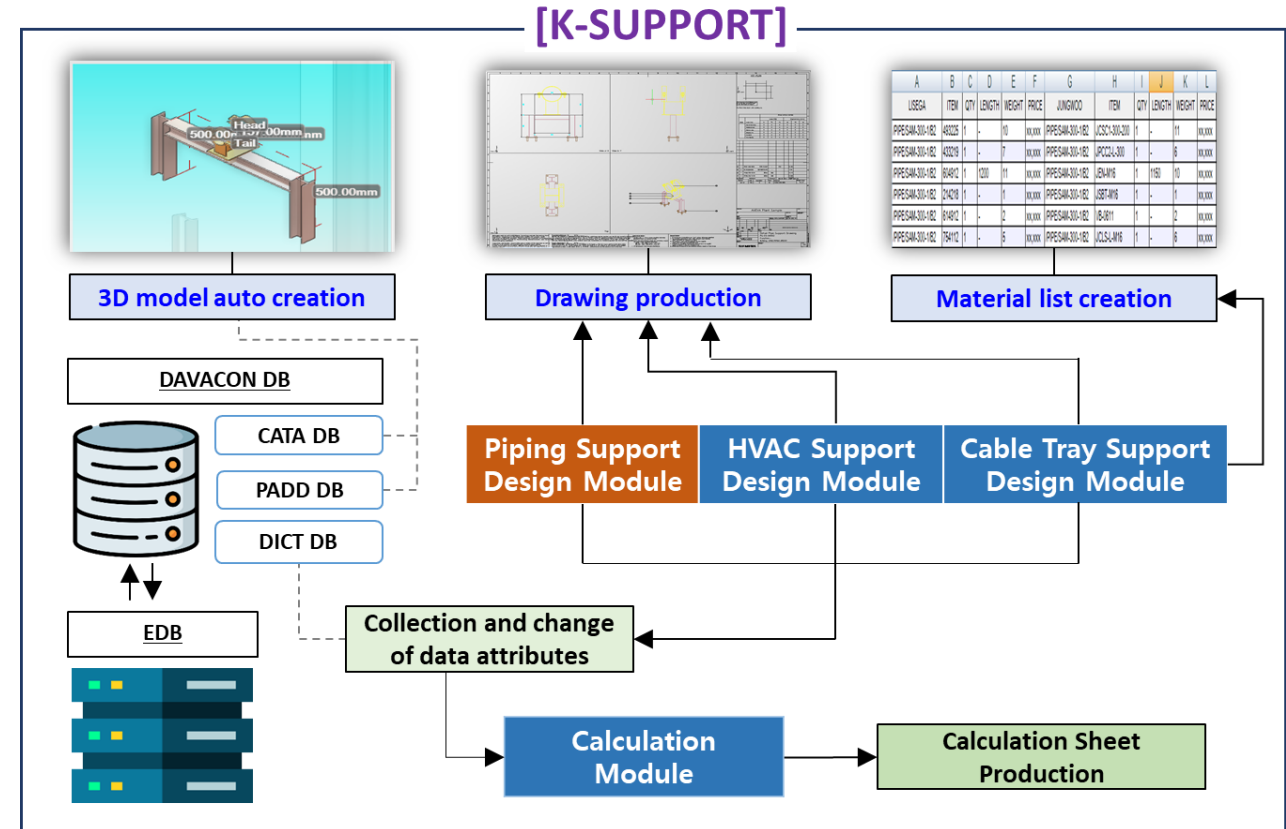
4. Conclusions

By using the K-SUPPORT, We have chance to

- minimize work time and manpower on massive amount of piping supports design work
- implement piping support 3D modeling quickly
- produce support design drawing fast and accurately
- maintain the mutual consistency between piping and piping support data

Development Continued

- Calculation module for calculation sheet production
- HVAC Support Design Module
- Cable Tray Support Design Module



Continued

Questions?

Thank you!

