Echoes From Space:

Command Groupings using Large-Scale Telemetry Data

Alexander Lattas

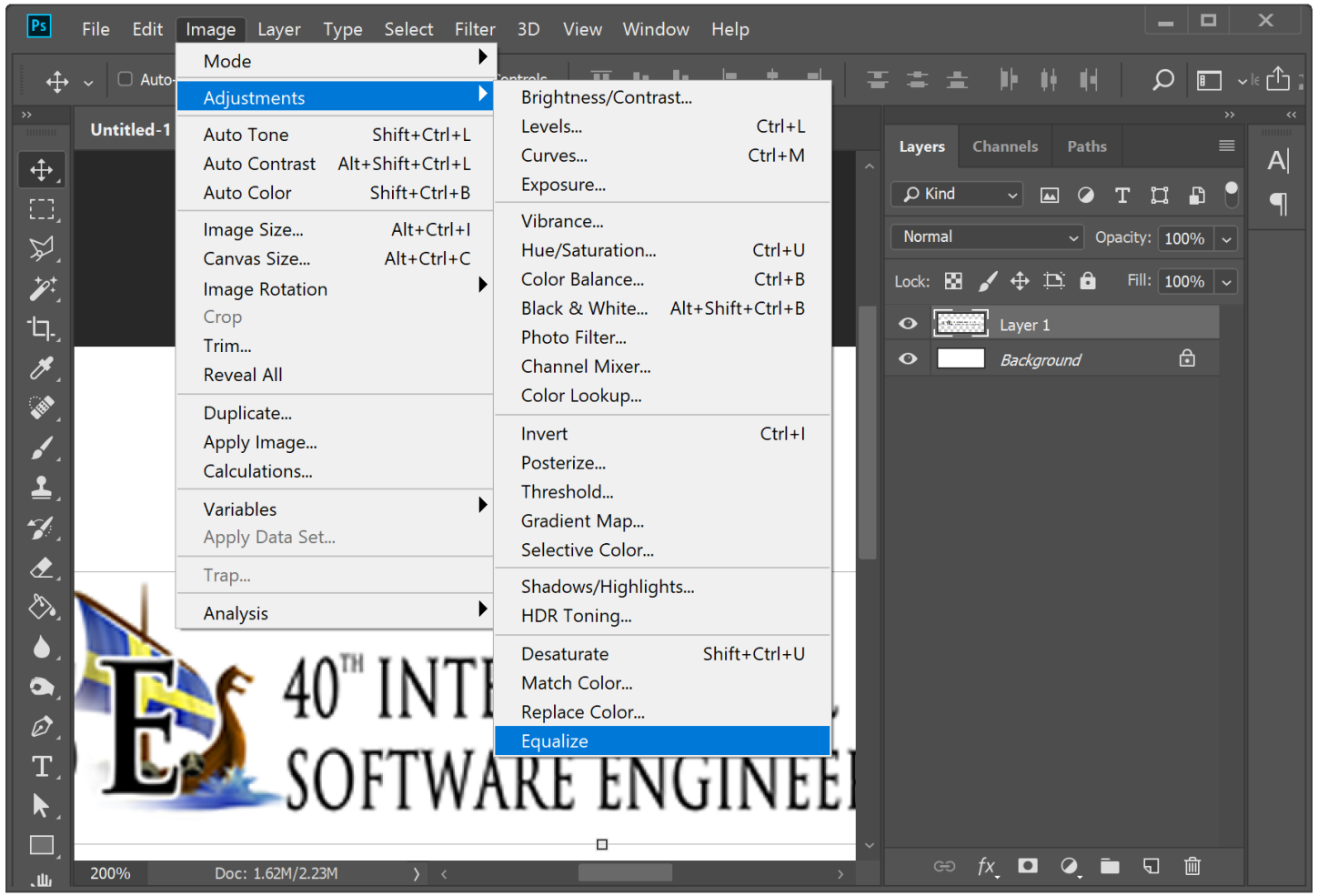
Imperial College London

Diomidis Spinellis

ΟΙΚΟΝΟΜΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS

ICSE 40TH INTERNATIONAL CONFERENCE ON SOFTWARE ENGINEERING MAY 27 - JUNE 3 2018 GOTHENBURG, SWEDEN

Command Grouping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Apply Image...
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Variables
Apply Data Set...
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Analysis
Brightness/Contrast...
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Curves... Ctrl+M
Exposure...
Vibrance...
Hue/Saturation... Ctrl+U
Color Balance... Ctrl+B
Black & White... Alt+Shift+Ctrl+B
Photo Filter...
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Color Lookup...
Invert Ctrl+I
Posterize...
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Gradient Map...
Selective Color...
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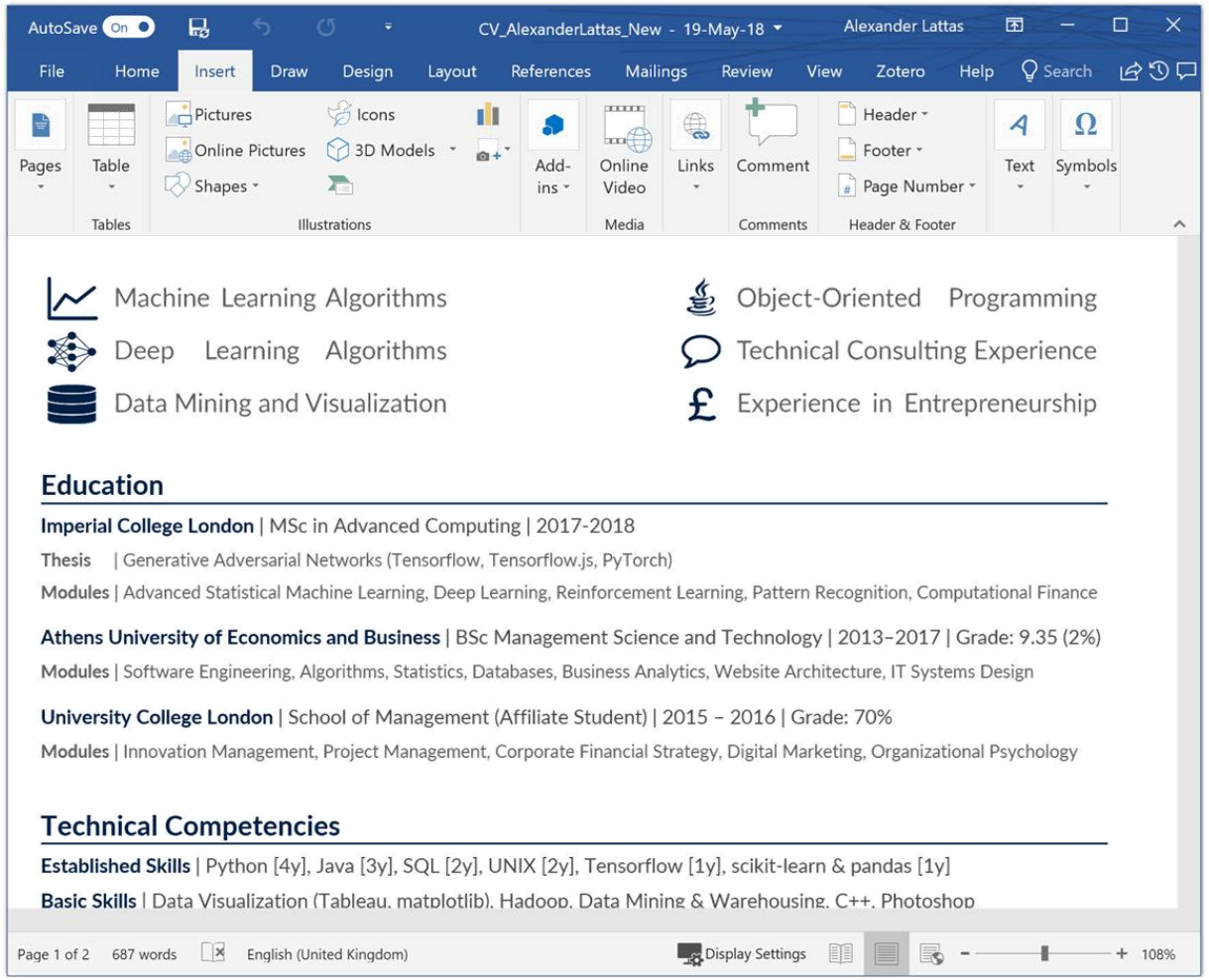
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Pages Table Pictures Online Pictures Shapes Icons 3D Models Add-ins Online Video Links Comment Header Footer Page Number Text Symbols
Tables Illustrations Media Comments Header & Footer
Machine Learning Algorithms
Deep Learning Algorithms
Data Mining and Visualization
Object-Oriented Programming
Technical Consulting Experience
Experience in Entrepreneurship
Education
Imperial College London | MSc in Advanced Computing | 2017-2018
Thesis | Generative Adversarial Networks (Tensorflow, Tensorflow.js, PyTorch)
Modules | Advanced Statistical Machine Learning, Deep Learning, Reinforcement Learning, Pattern Recognition, Computational Finance
Athens University of Economics and Business | BSc Management Science and Technology | 2013–2017 | Grade: 9.35 (2%)
Modules | Software Engineering, Algorithms, Statistics, Databases, Business Analytics, Website Architecture, IT Systems Design
University College London | School of Management (Affiliate Student) | 2015 – 2016 | Grade: 70%
Modules | Innovation Management, Project Management, Corporate Financial Strategy, Digital Marketing, Organizational Psychology
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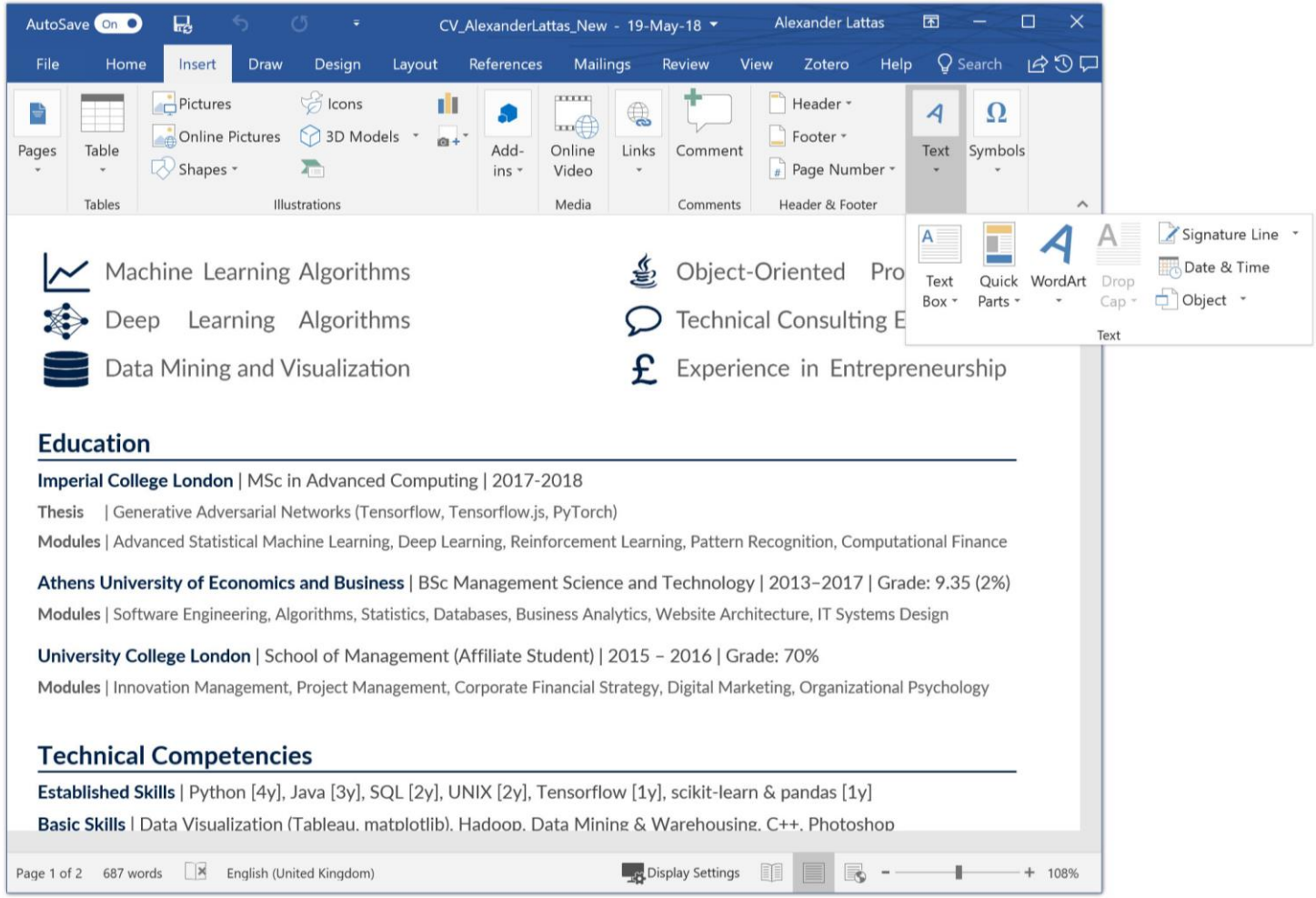
Page 1 of 2 687 words English (United Kingdom) Display Settings 108%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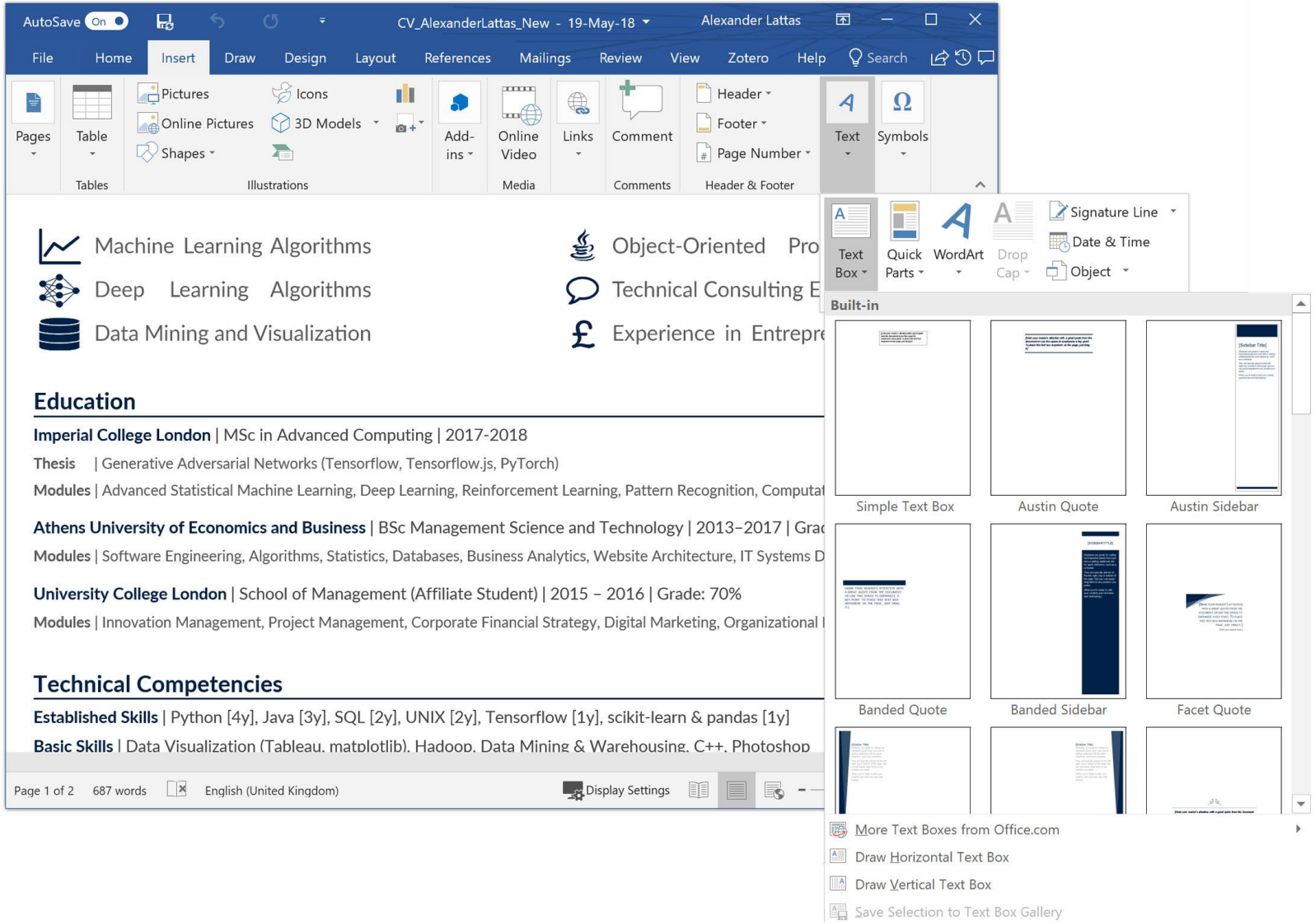
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Austin Sidebar
Banded Quote
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More Text Boxes from Office.com
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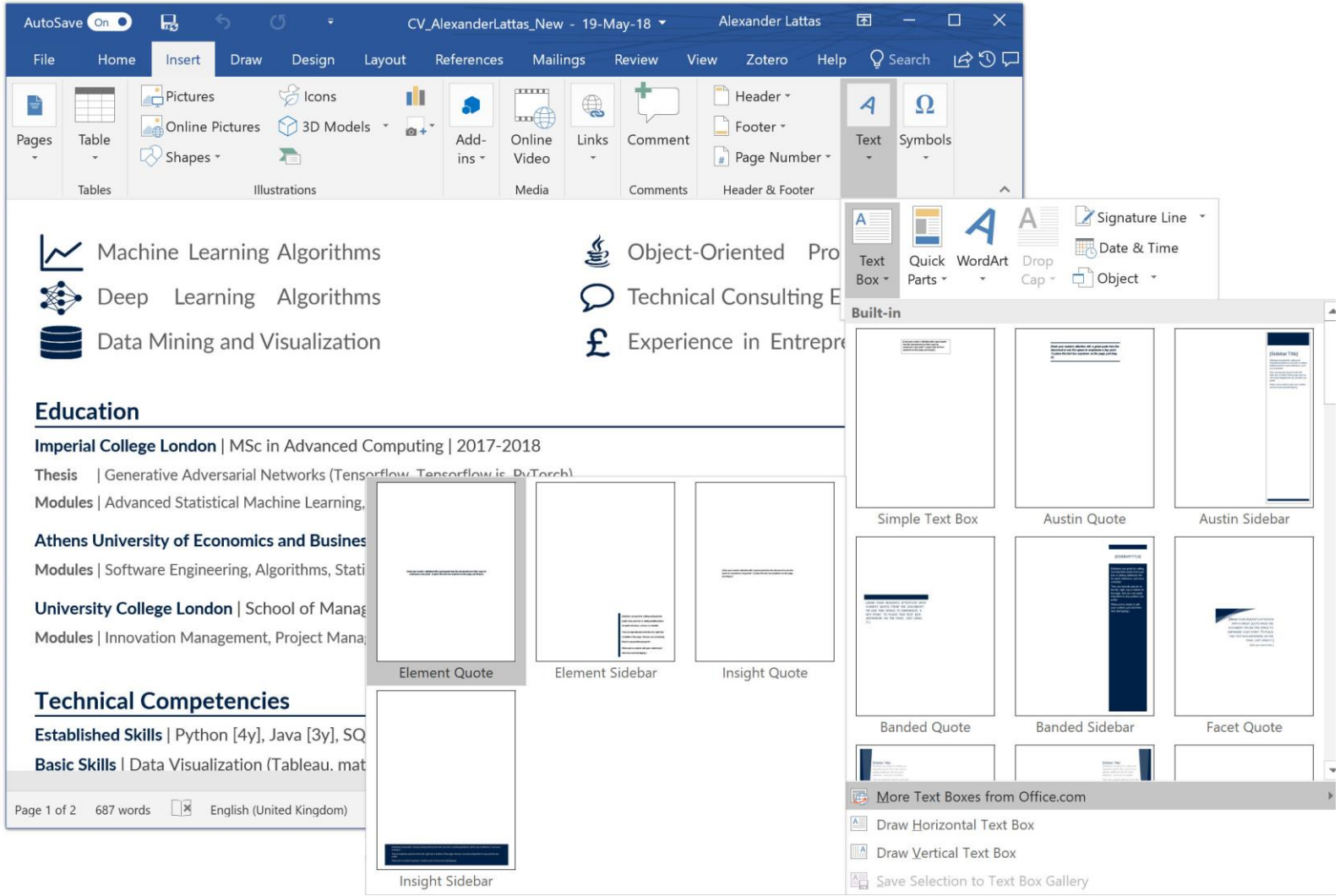
Save Selection to Text Box Gallery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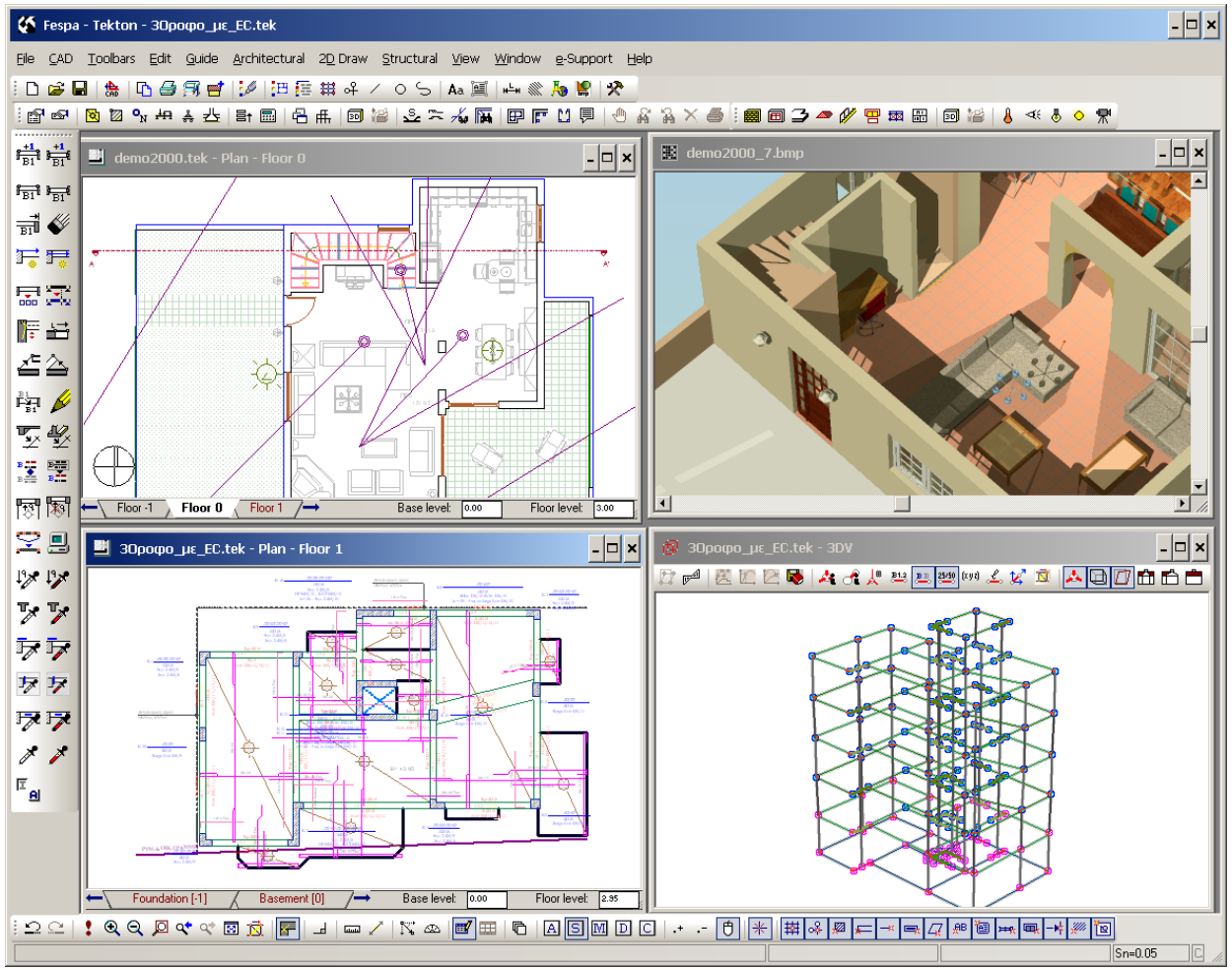
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demo2000.tek - Plan - Floor 0
Floor -1 Floor 0 Floor 1 Base level: 0.00 Floor level: 3.00
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Foundation [-1] Basement [0] Base level: 0.00 Floor level: 2.95
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Command Grouping

Systematic method for grouping commands into multi-level menus and toolbars for

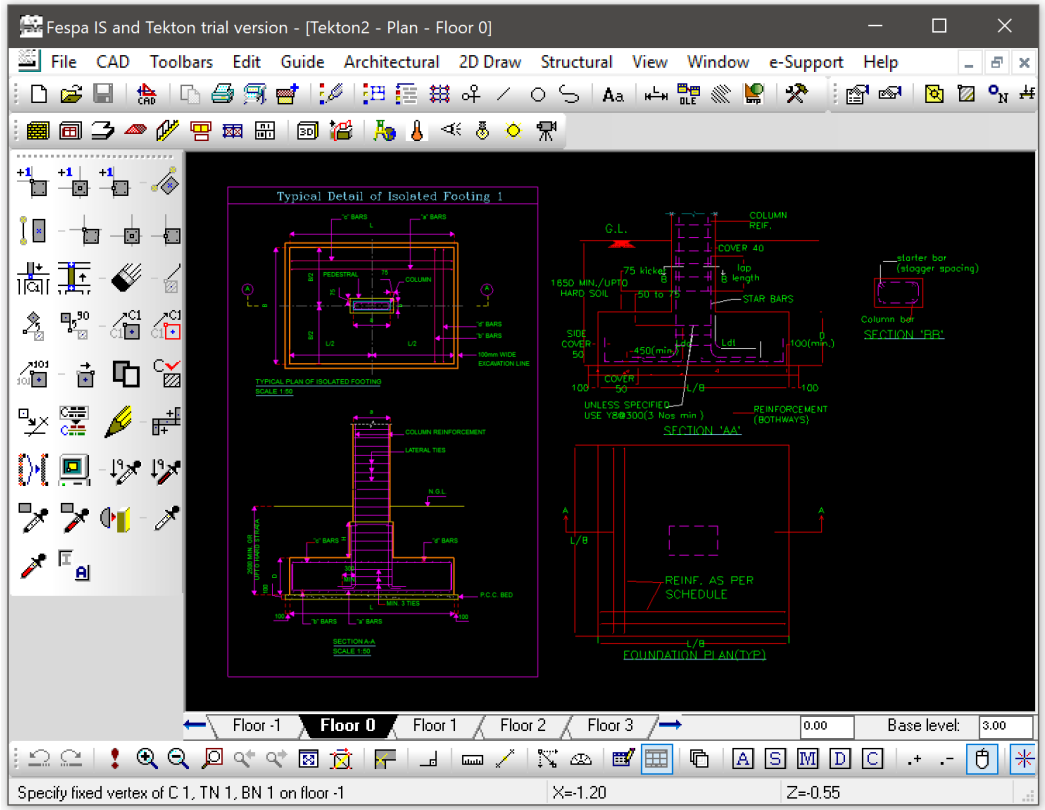
- ✔ User usability and speed
- ✔ Improved GUI design process

Model & Data

Keystroke-Level Model (KLM)

Card et al., 1980

$$T_{command} = T_{Mental} + T_{Move} + T_{Point} + T_{Key} + T_{System}$$



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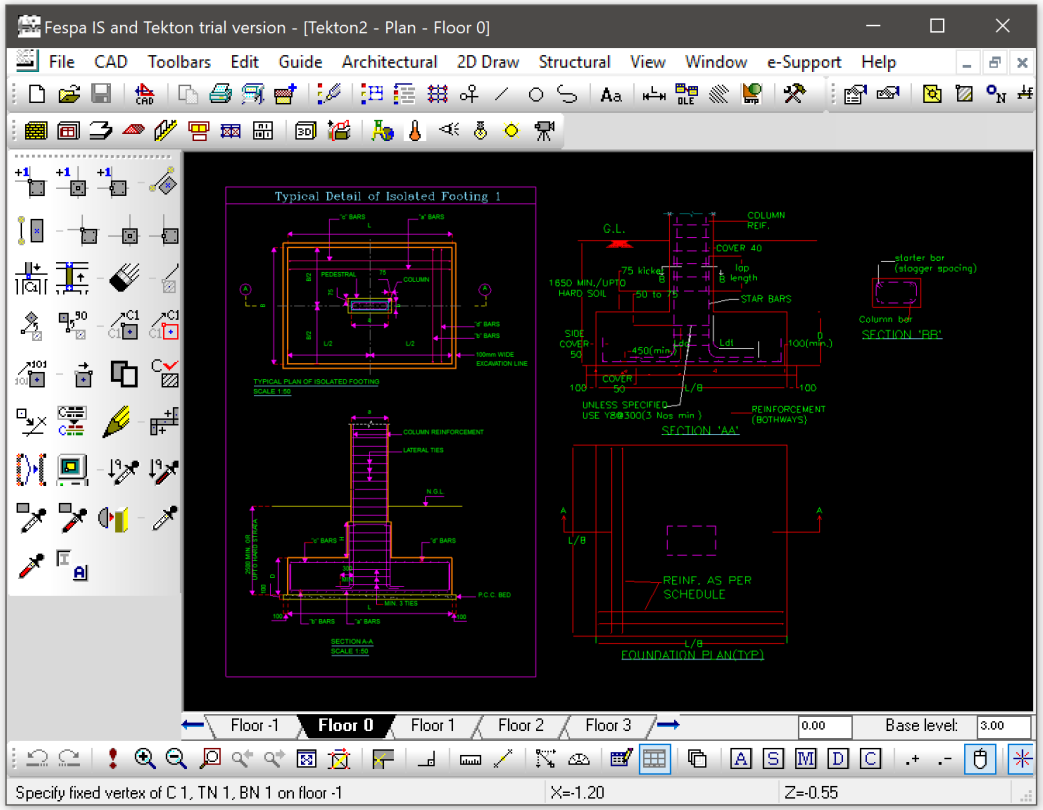

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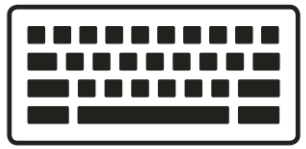

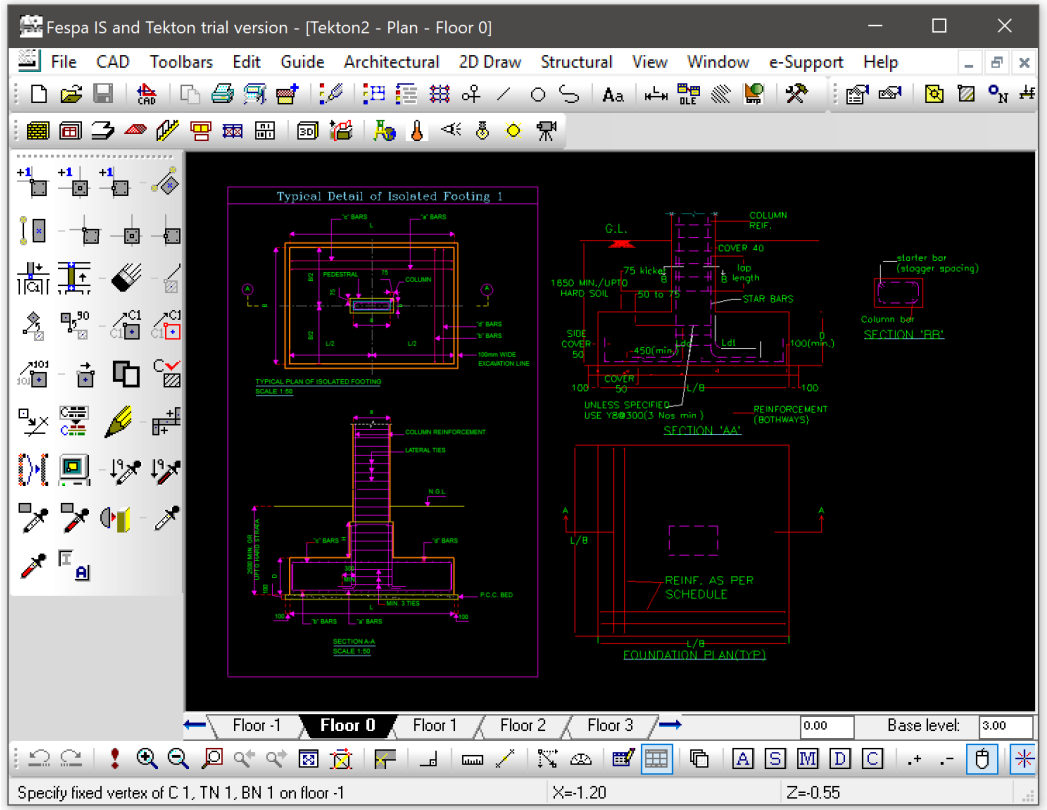

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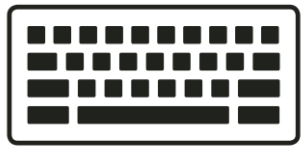

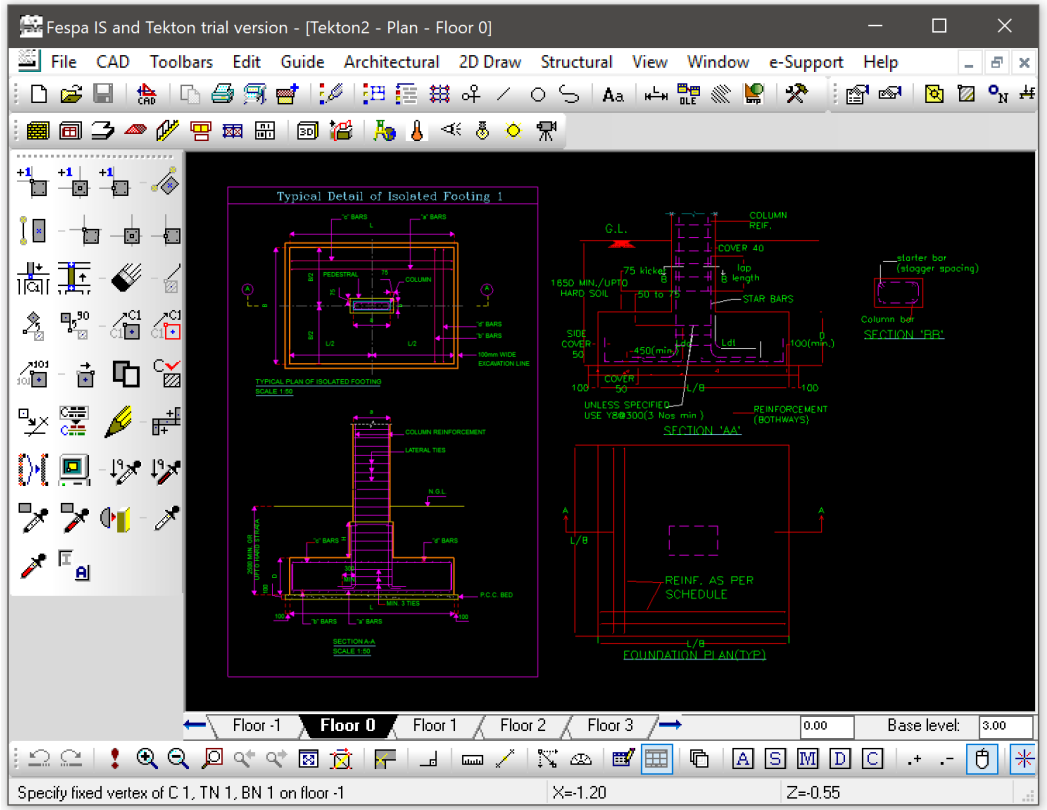

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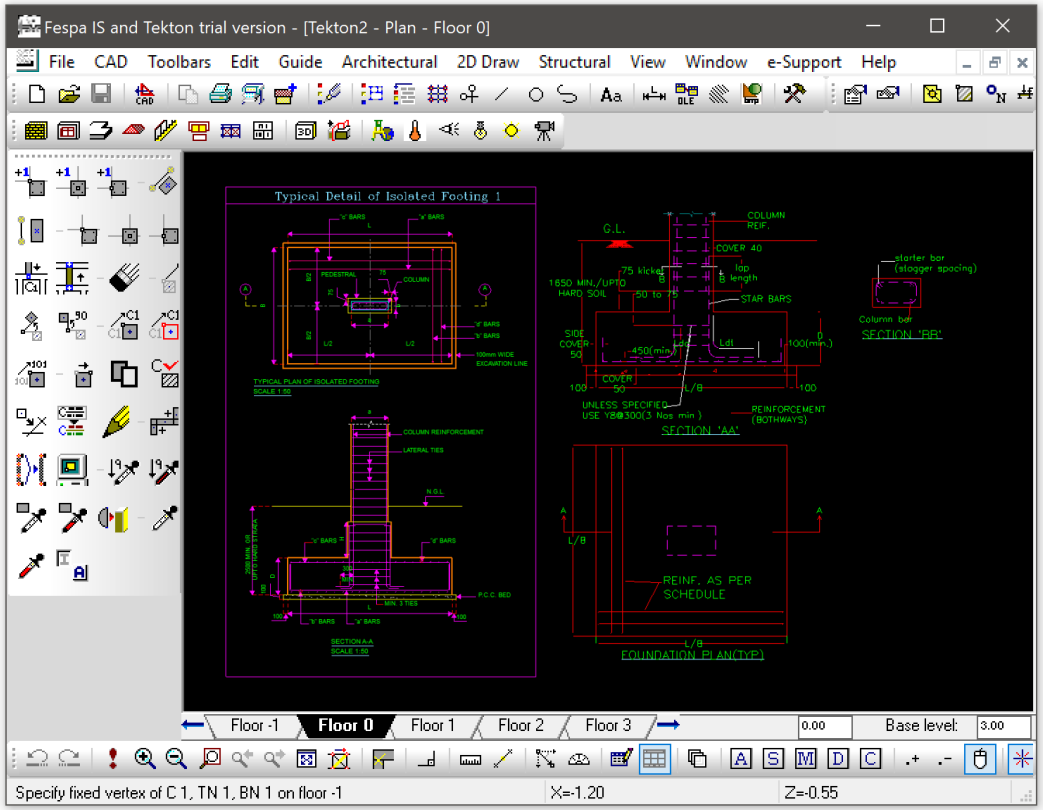

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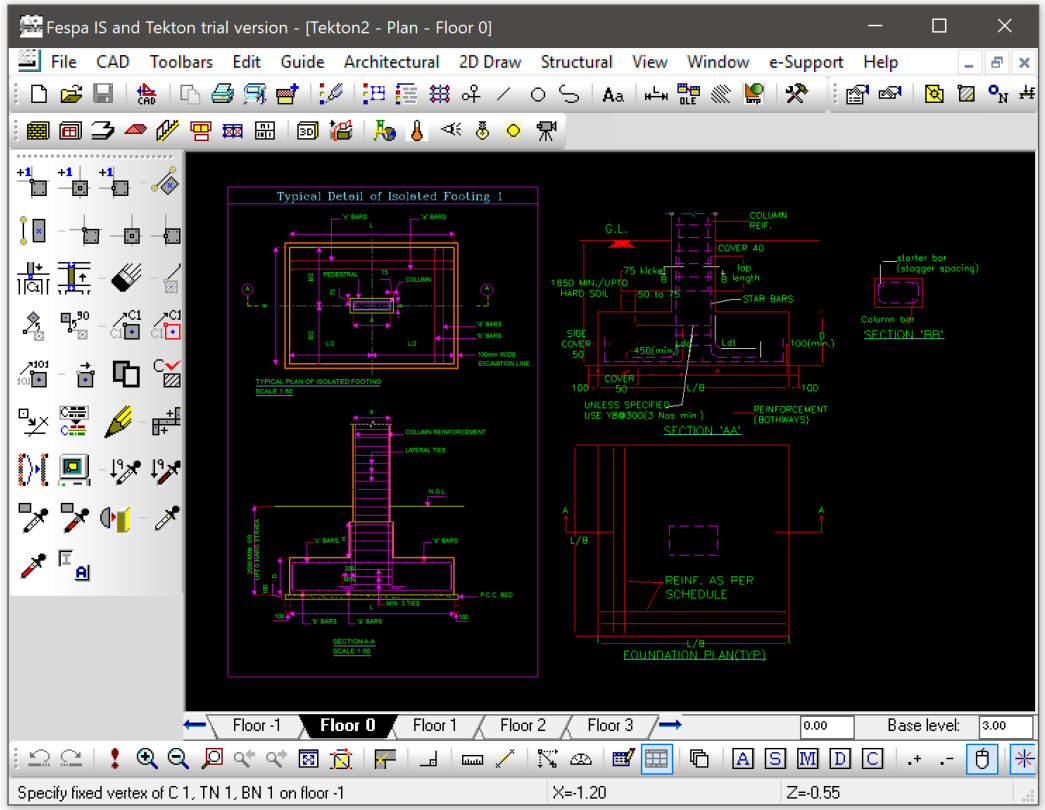

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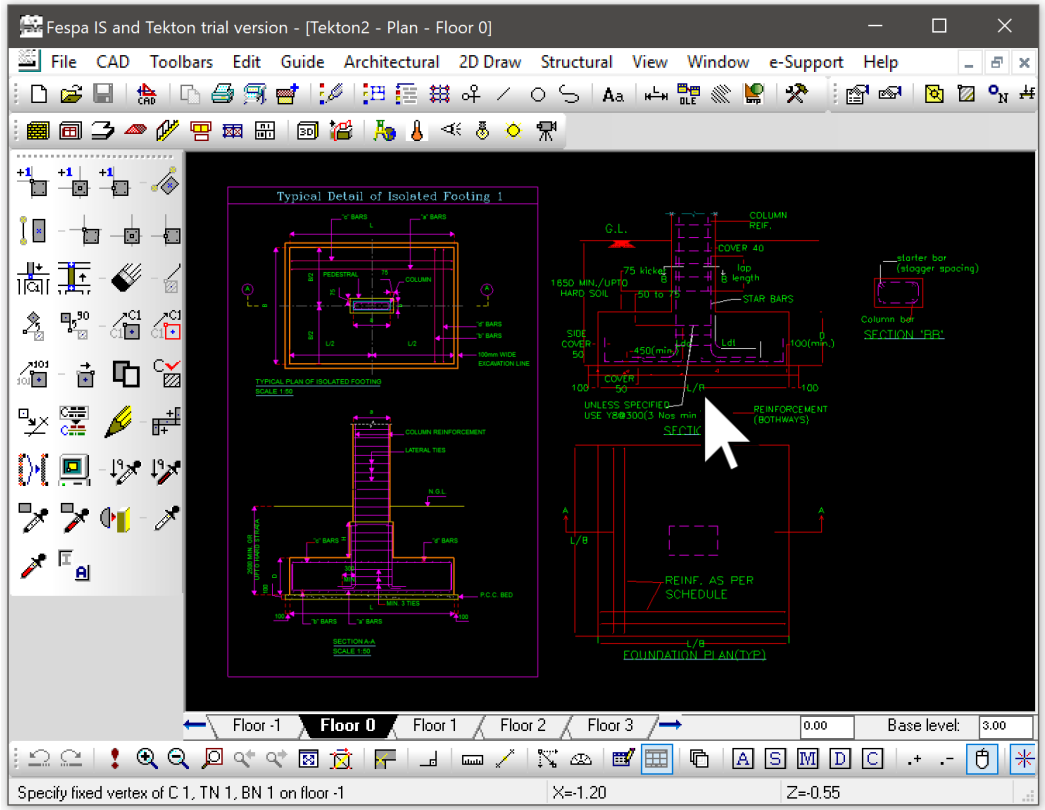

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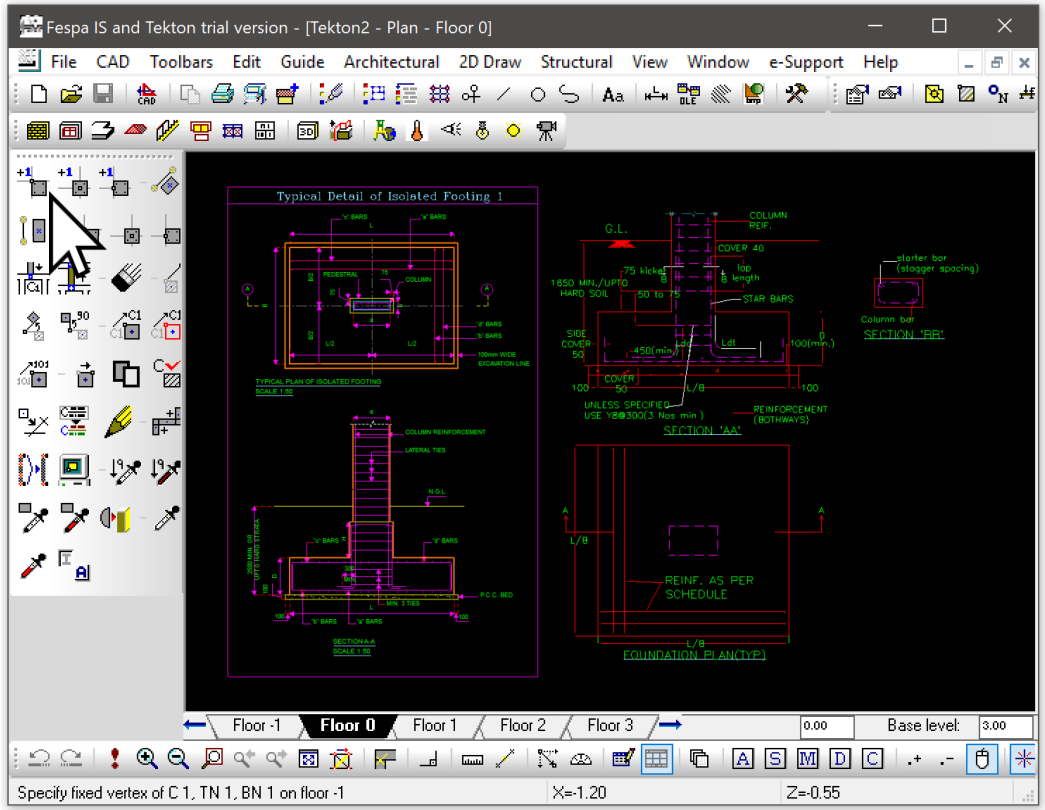

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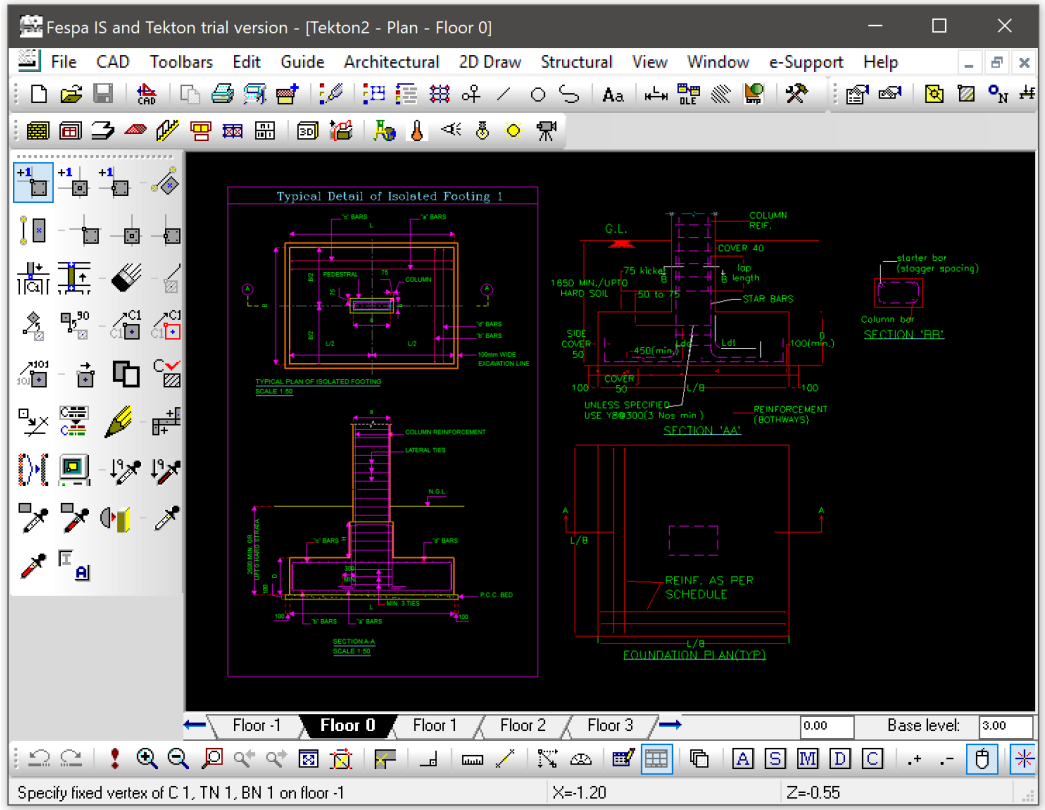

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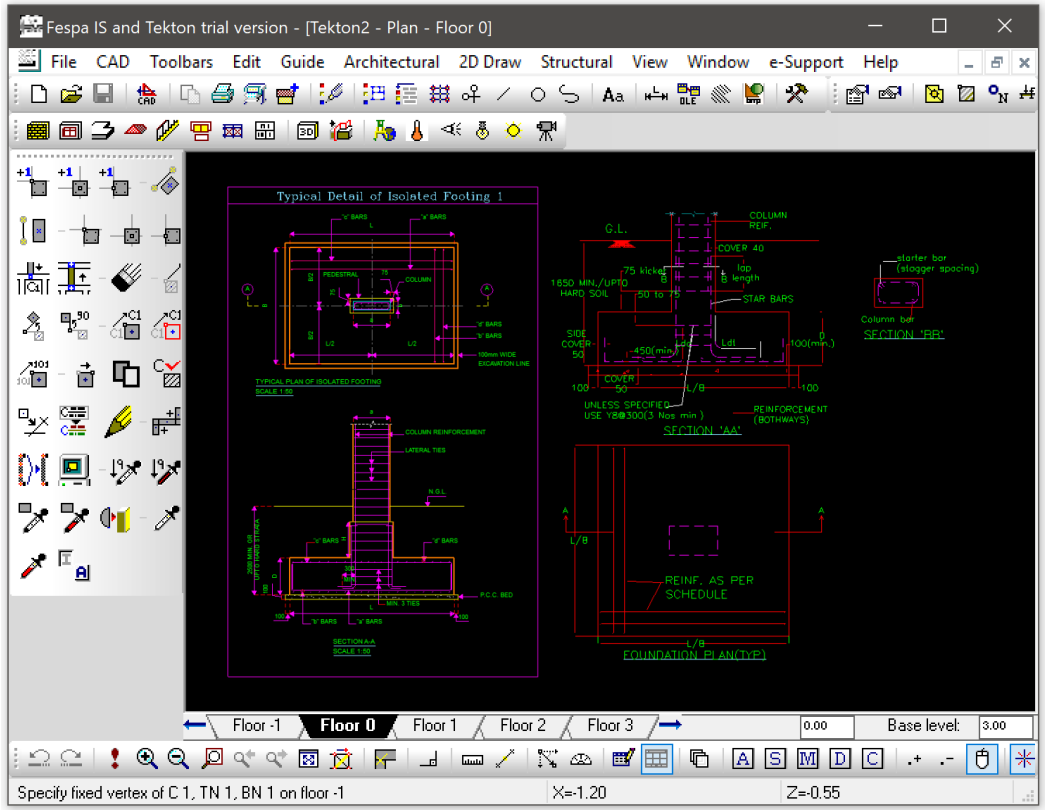
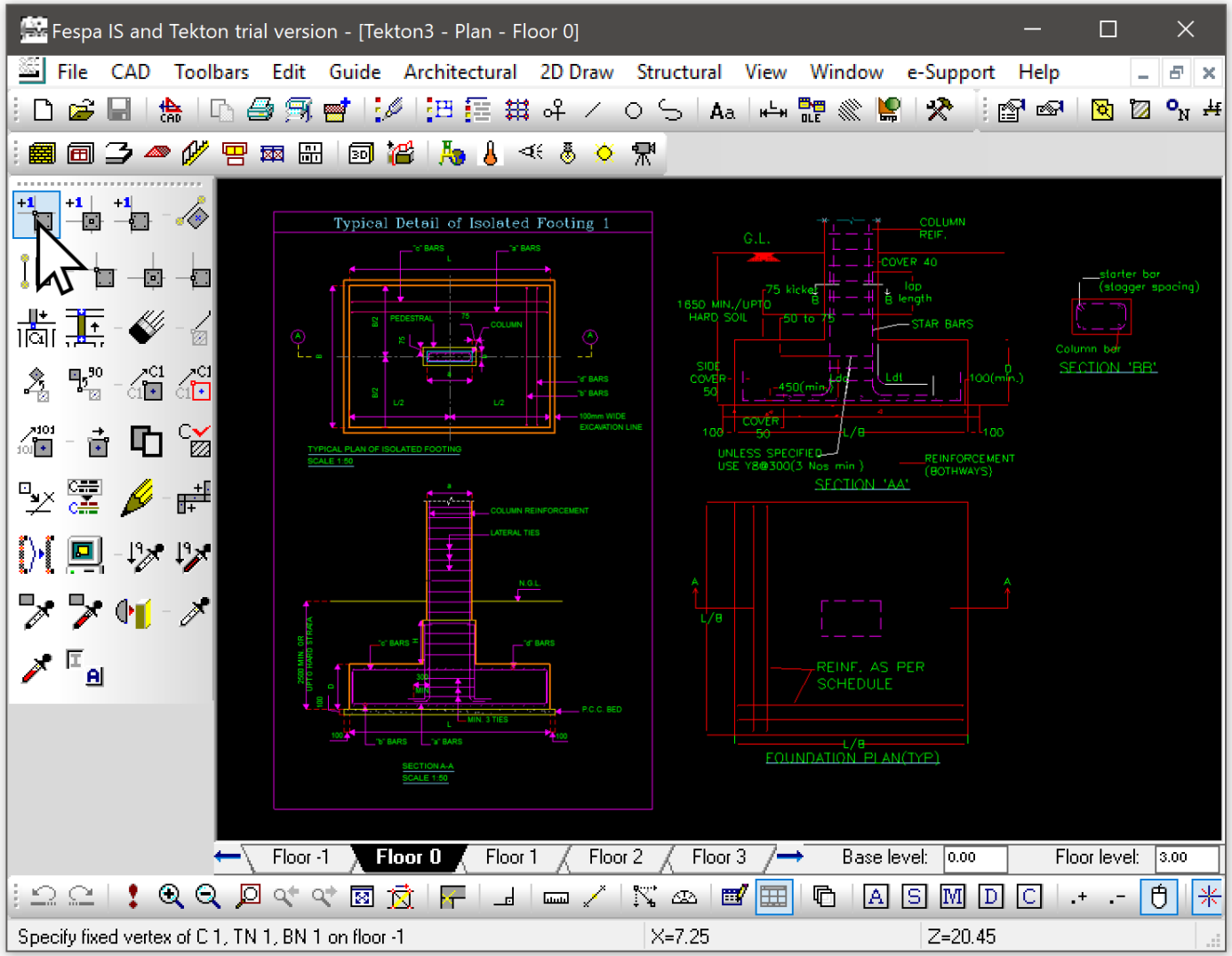
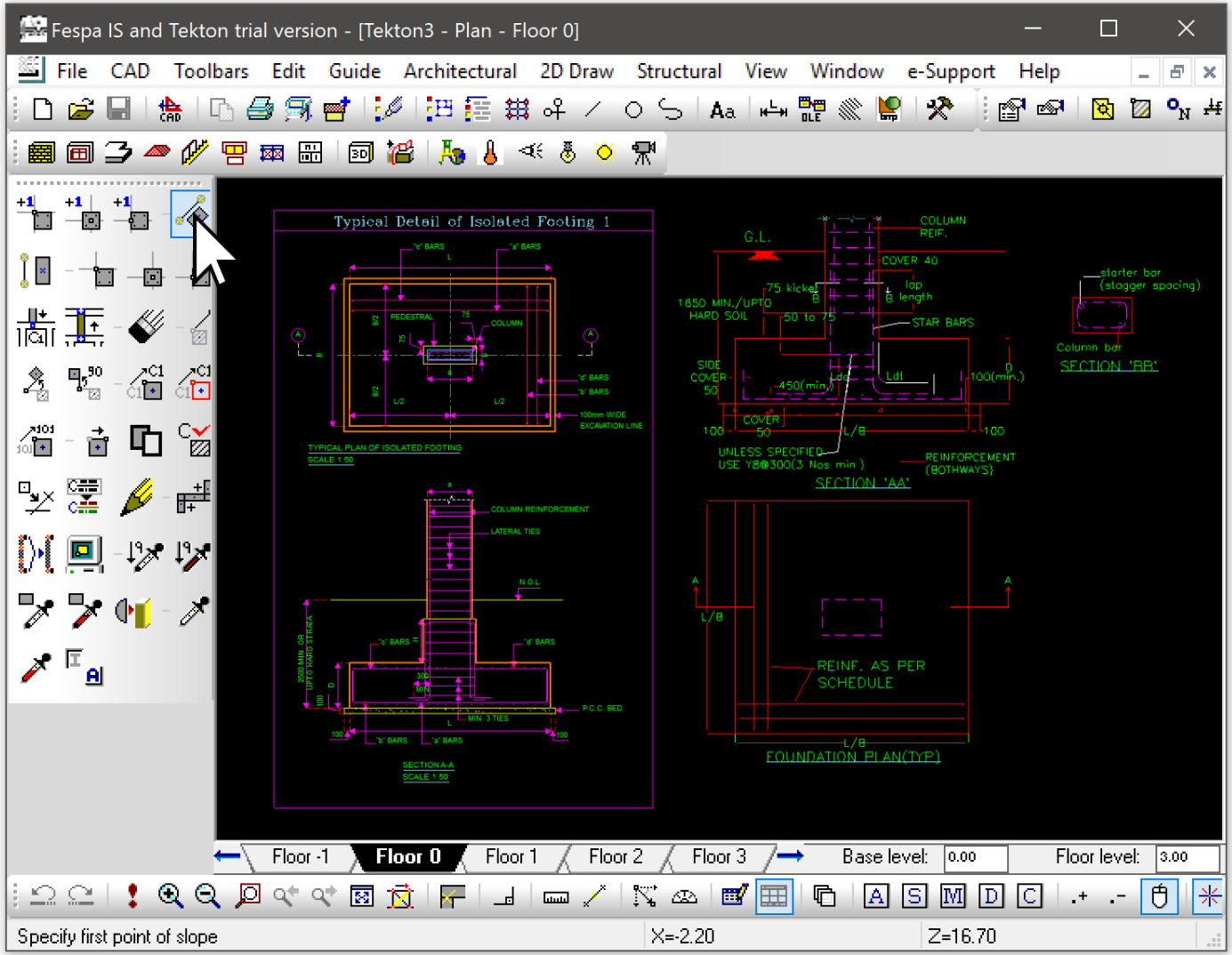


T_{Same}


Fespa IS and Tekton trial version - [Tekton3 - Plan - Floor 0]
File CAD Toolbars Edit Guide Architectural 2D Draw Structural View Window e-Support Help
Typical Detail of Isolated Footing 1
TYPICAL PLAN OF ISOLATED FOOTING
SECTION A-A
SECTION 'AA'
SECTION 'BB'
FOUNDATION PLAN(TYP)
REINF. AS PER SCHEDULE
Floor -1 Floor 0 Floor 1 Floor 2 Floor 3
Base level: 0.00
Floor level: 3.00
Specify fixed vertex of C 1, TN 1, BN 1 on floor -1
X=7.25
Z=20.45

T_{Same}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Typical Detail of Isolated Footing 1
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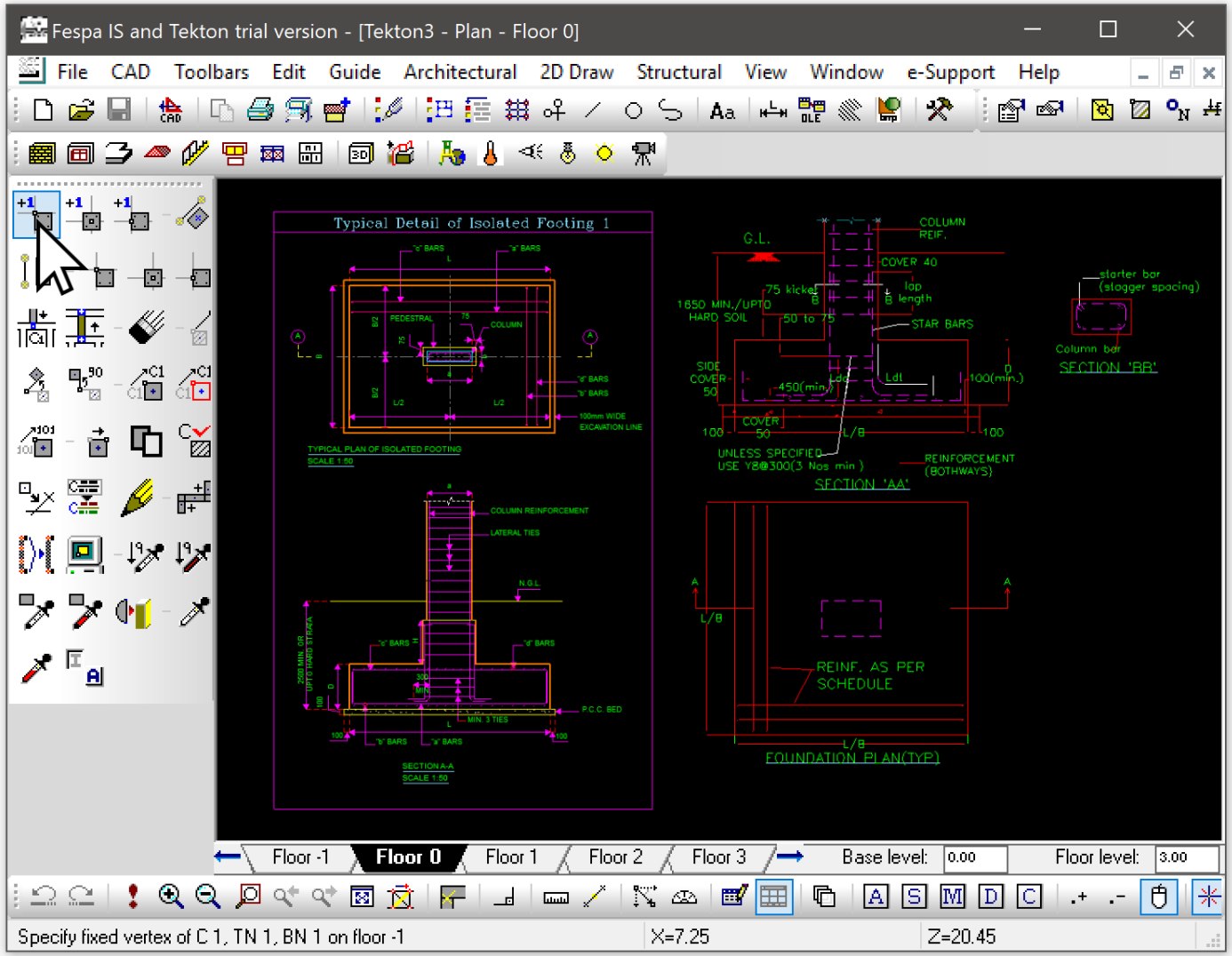
SCALE 1:50
SECTION A-A
SCALE 1:50
SECTION 'AA'
SECTION 'BB'
FOUNDATION PLAN(TYP)
REINF. AS PER SCHEDULE
REINFORCEMENT (BOTHWAYS)
Floor -1 Floor 0 Floor 1 Floor 2 Floor 3
Base level: 0.00
Floor level: 3.00
Specify first point of slope
X=-2.20
Z=16.70

$T_{different}$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REINF. AS PER SCHEDULE
Floor -1 Floor 0 Floor 1 Floor 2 Floor 3
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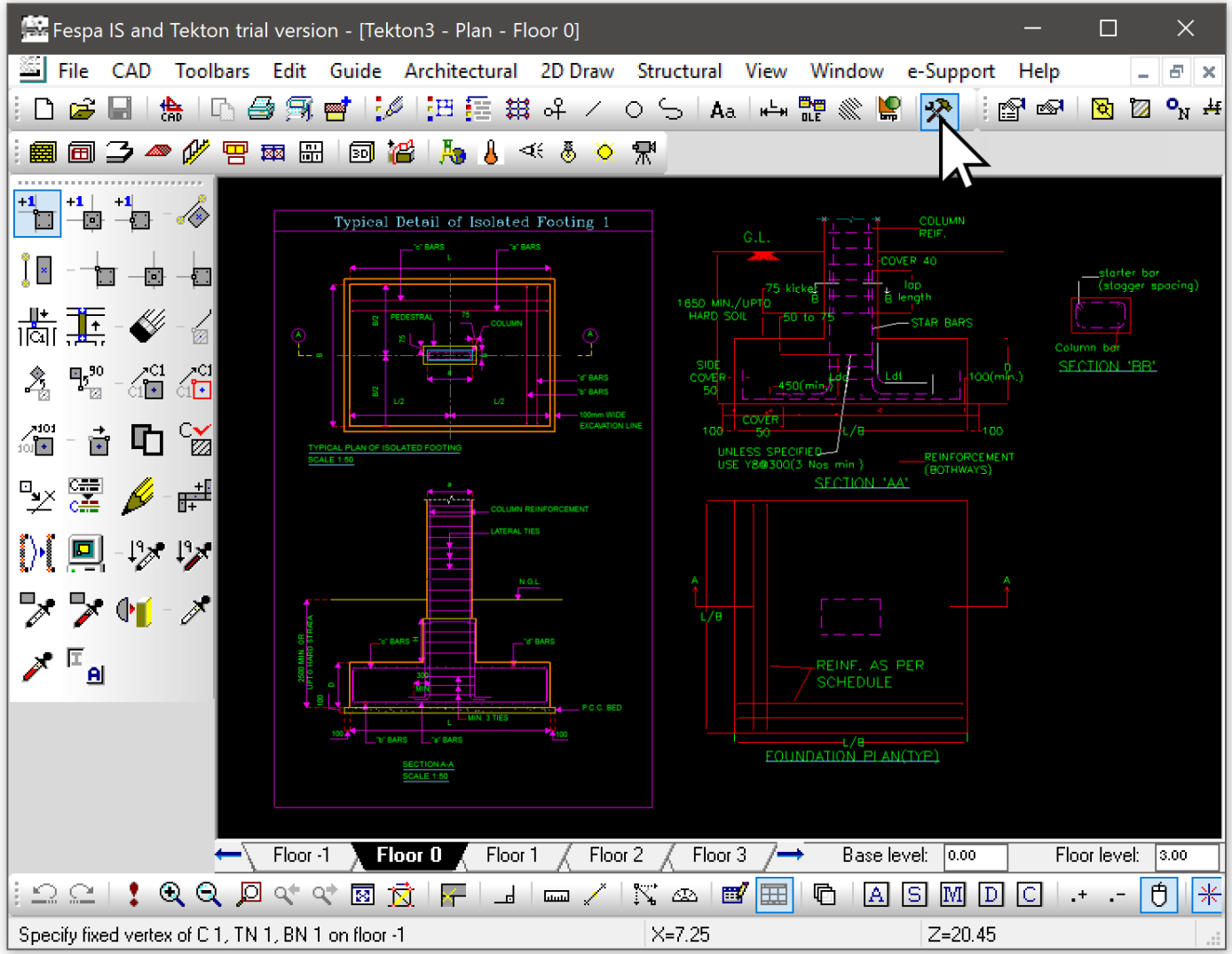
Floor level: 3.00
Specify fixed vertex of C 1, TN 1, BN 1 on floor -1
X=7.25
Z=20.45

$T_{different}$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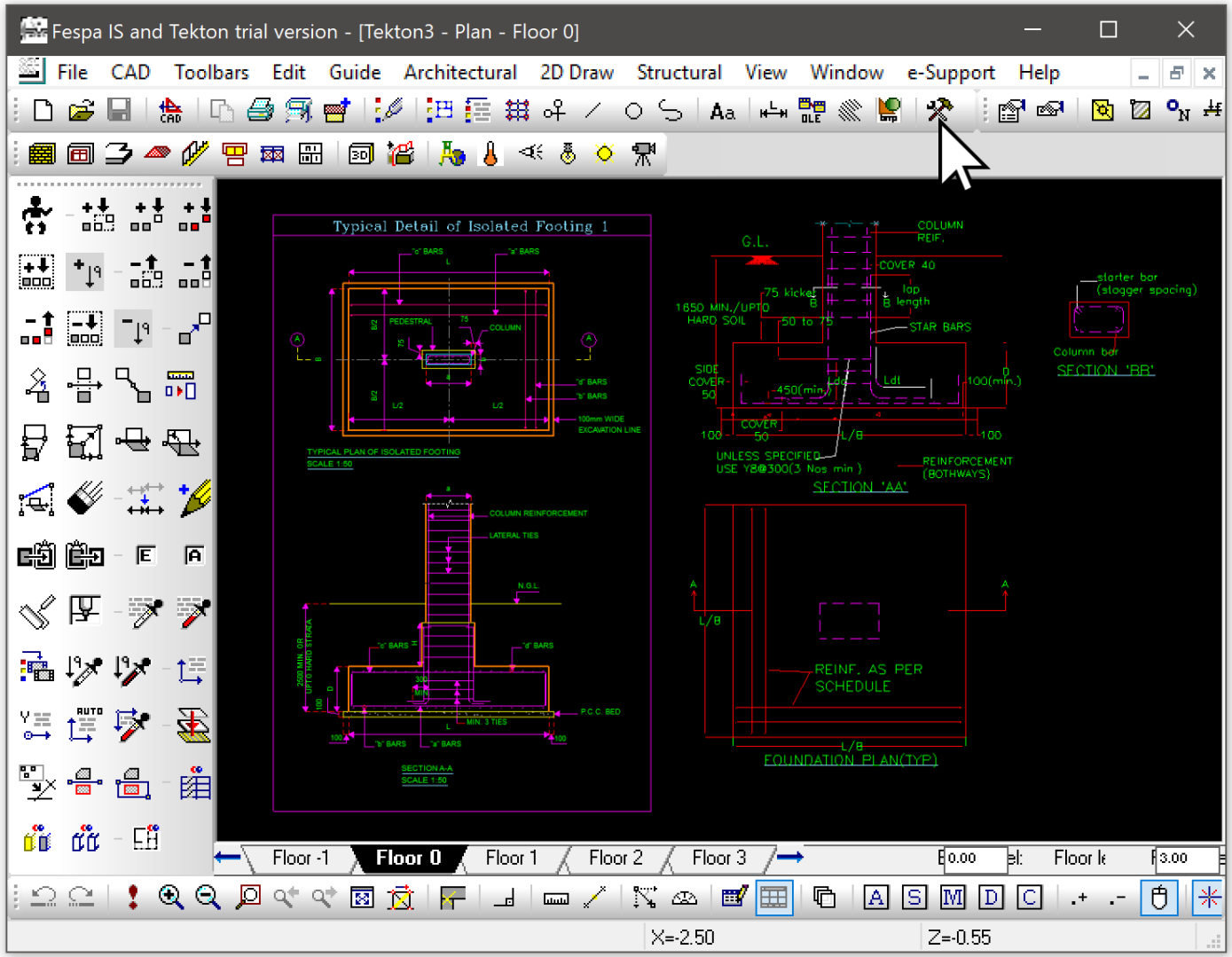
$T_{different}$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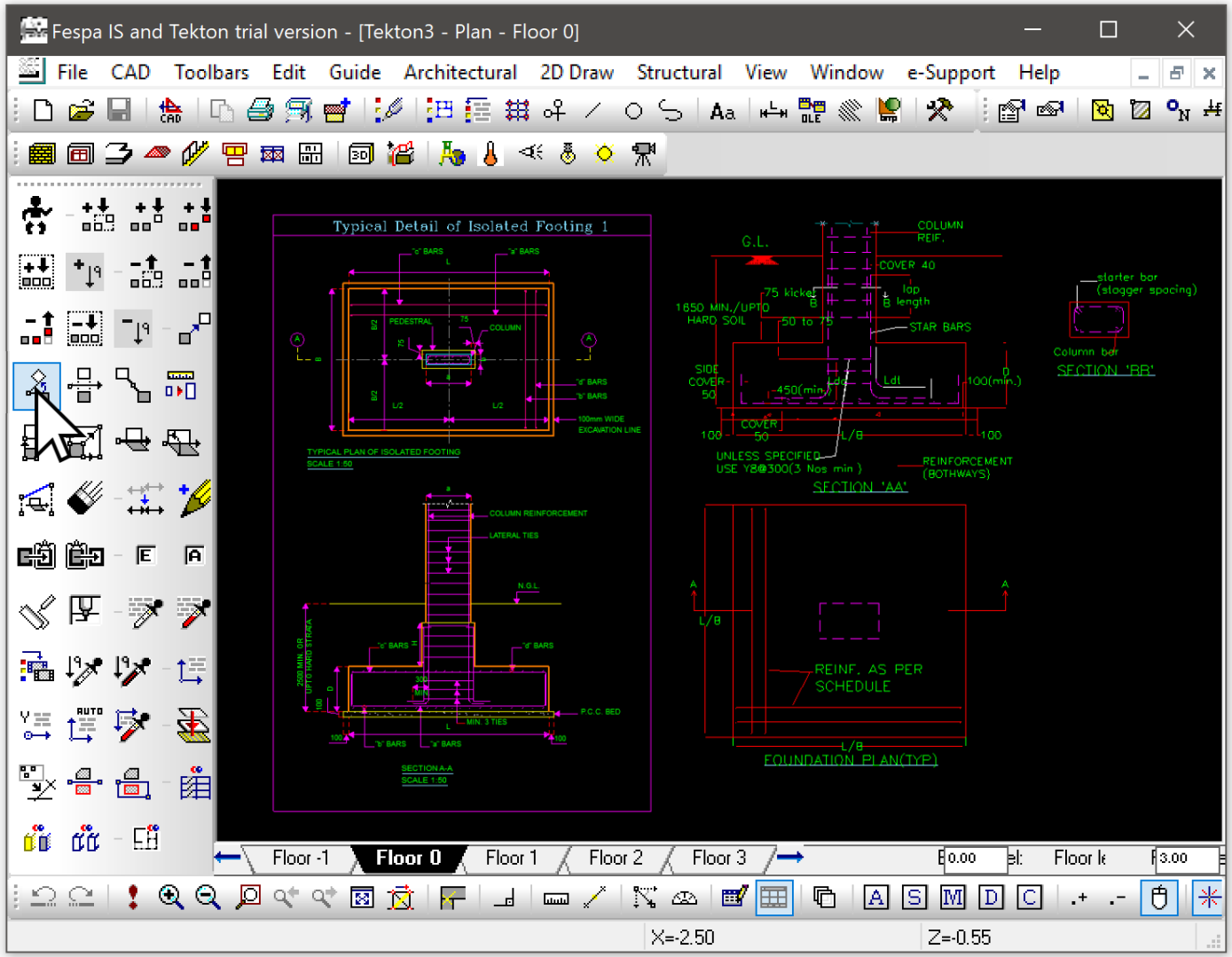
TYPICAL PLAN OF ISOLATED FOOTING
SCALE 1:50
SECTION A-A
SCALE 1:50
SECTION 'AA'
SECTION 'BB'
FOUNDATION PLAN(TYP)
REINF. AS PER SCHEDULE
Floor -1 Floor 0 Floor 1 Floor 2 Floor 3
X=-2.50
Z=-0.55

$T_{different}$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Typical Detail of Isolated Footing 1
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SCALE 1:50
SECTION A-A
SCALE 1:50
G.L.
COVER 40
STAR BARS
SECTION 'AA'
SECTION 'BB'
REINF. AS PER SCHEDULE
FOUNDATION PLAN(TYP)
Floor -1 Floor 0 Floor 1 Floor 2 Floor 3
X=-2.50
Z=-0.55

Our Model

Eliminate T_{System}

Combine rest to:

$\boldsymbol{T_{Same}}$: previous command in same entity

$\boldsymbol{T_{Different}}$: previous command in different entity

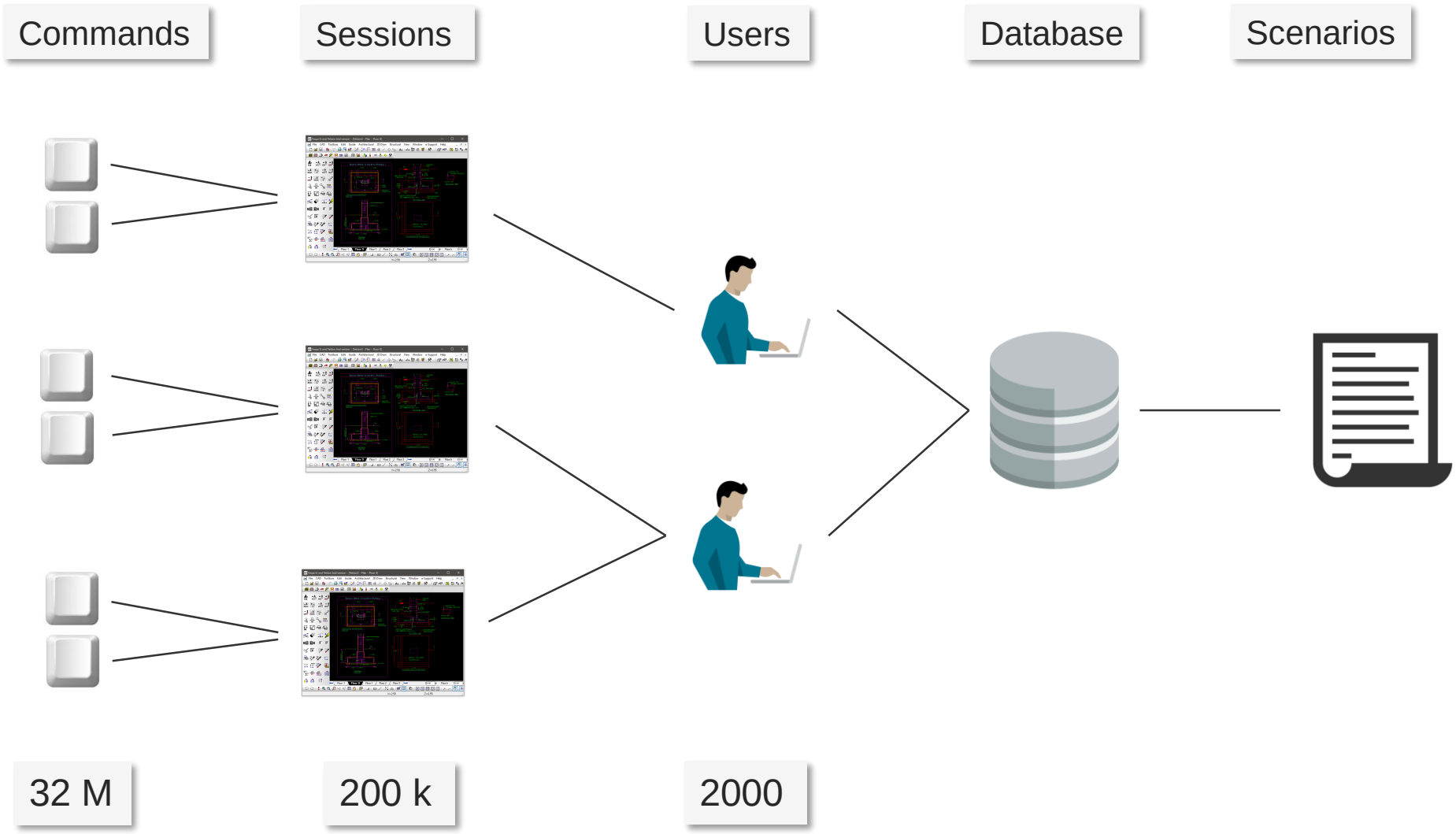
Count commands:

$\boldsymbol{N_{Same}}$: previous command in same entity

$\boldsymbol{N_{Different}}$: previous command in different entity

$\boldsymbol{N_{Toolbar}}$: command always available in a toolbar

$$\boldsymbol{T_{Total}} = T_{Same} \times (N_{Same} + N_{Toolbar}) + T_{Different} \times \mathrm{N}_{\mathrm{Different}}$$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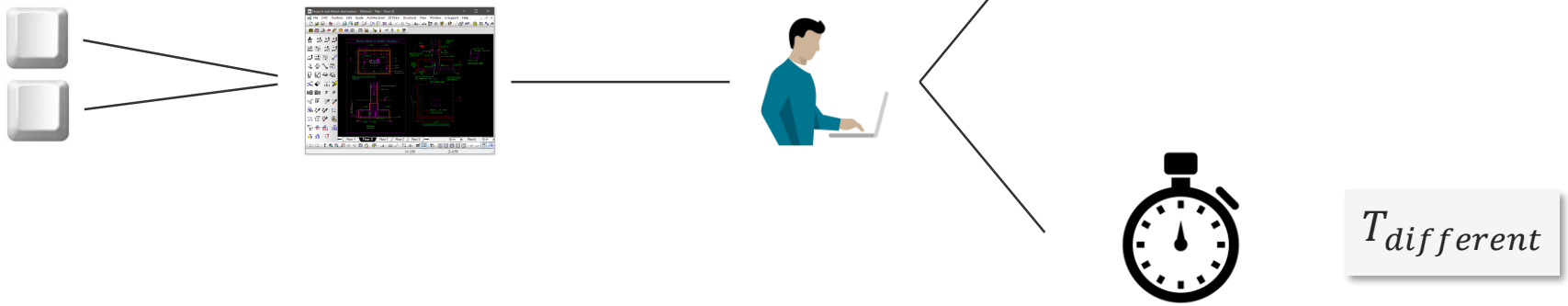
2000

Commands

Sessions

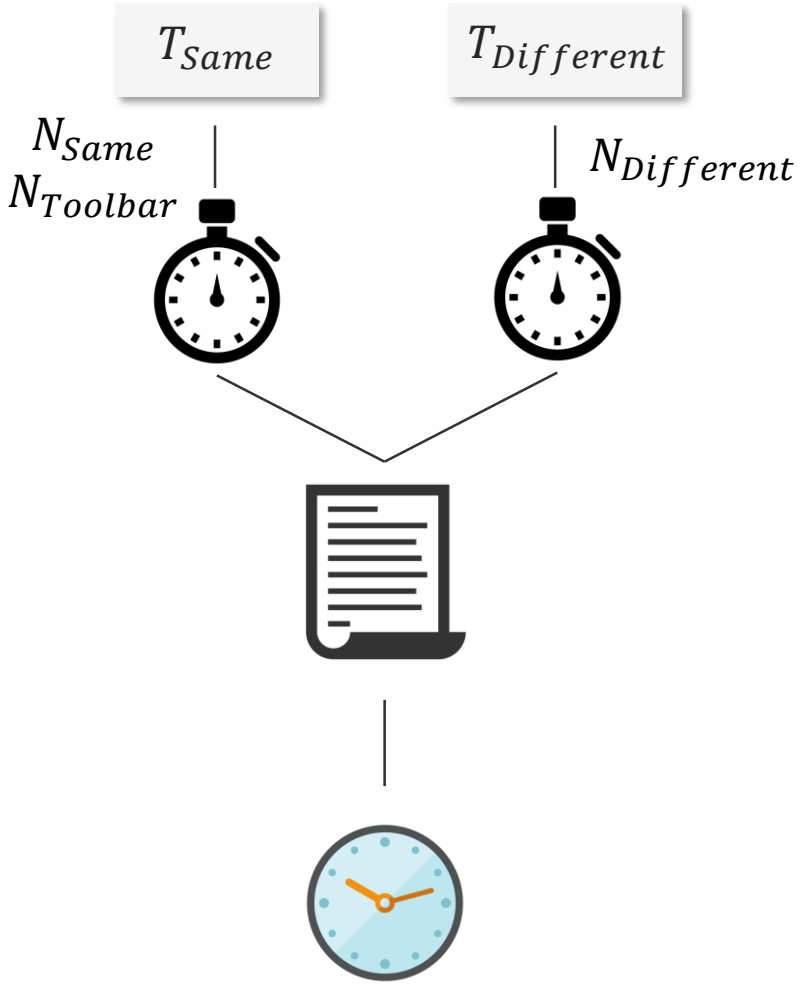
Users



Optimization Algorithms

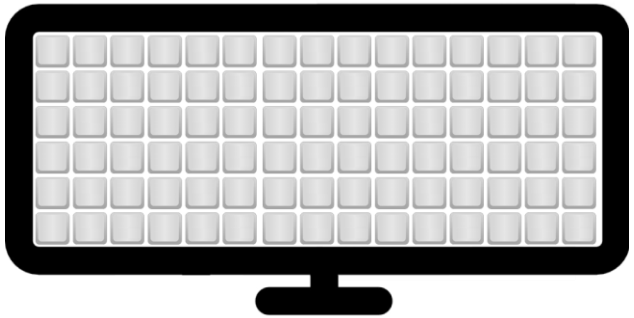
CURRENT

Measurement with the GUI
at the current setup.



ALL

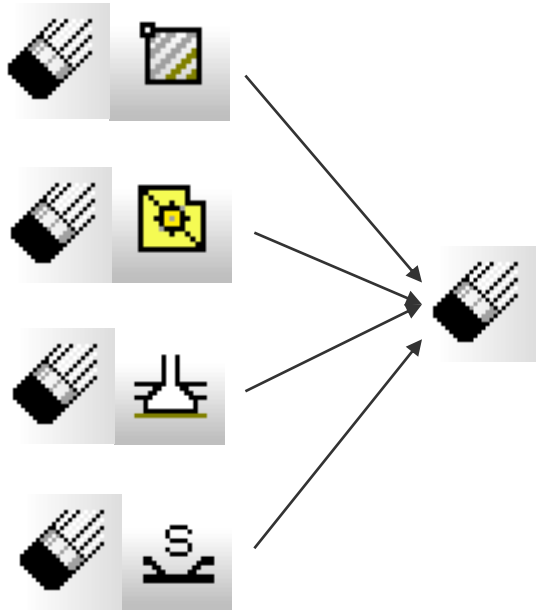
All commands available directly on the screen.



18%

GROUP

Group together commands between entities



0.5%

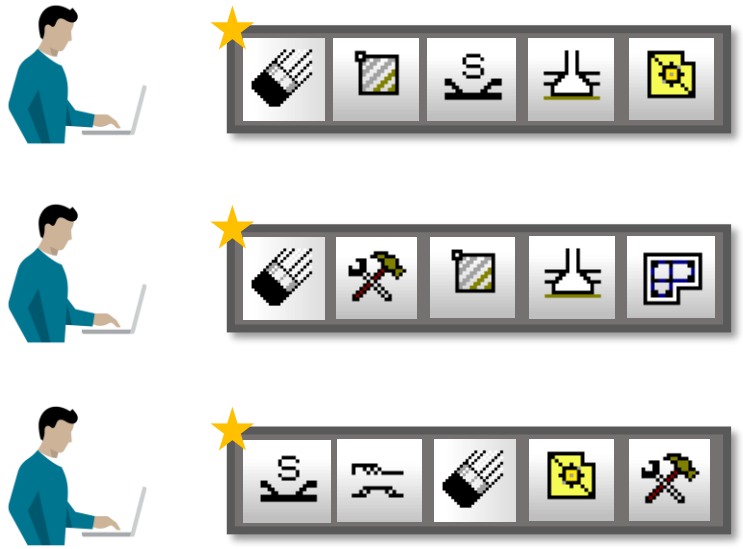
NAIVE

N most frequent commands always available on a toolbar

13%

MRU-B

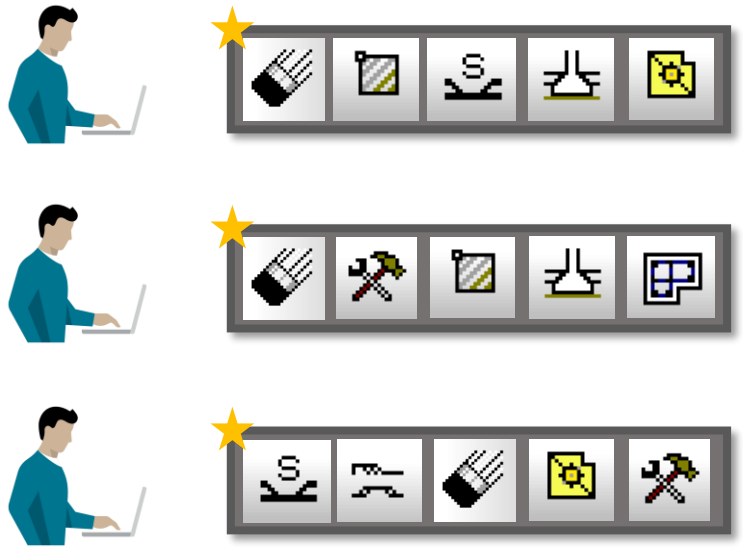
N most frequent commands always available on a toolbar
For each user,
from a small batch.

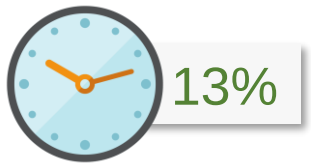


10%

MRU-O

N most frequent commands always available on a toolbar
For each user,
***online**.*

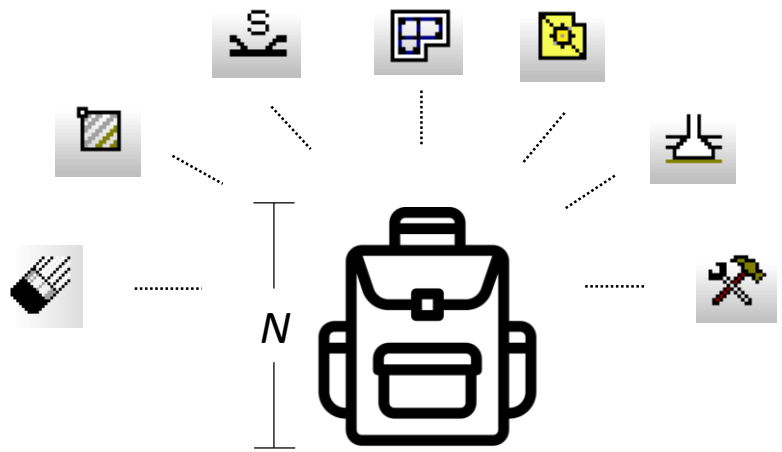




13%

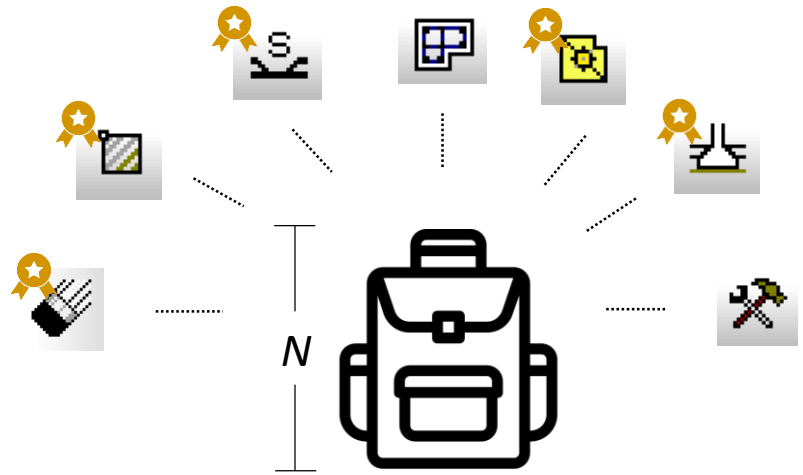
OPT(KS)

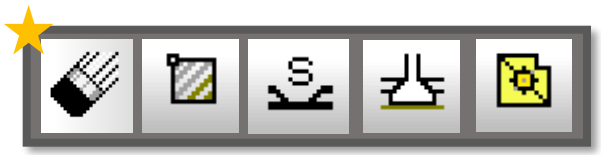
N best commands
always available on a toolbar
a heuristic Knapsack algorithm.



OPT(KS)

N best commands
always available on a toolbar
a heuristic Knapsack algorithm.





OPT(GA)

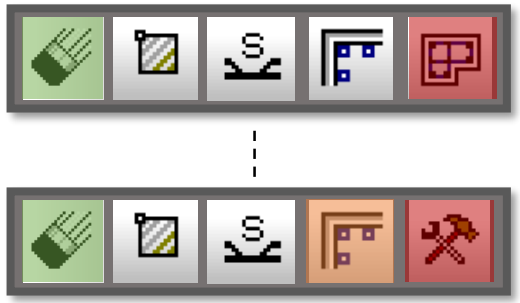
N best commands
always available on a toolbar
a stochastic Genetic algorithm.

17.40%

OPT(GA)

N best commands
always available on a toolbar
a stochastic Genetic algorithm.

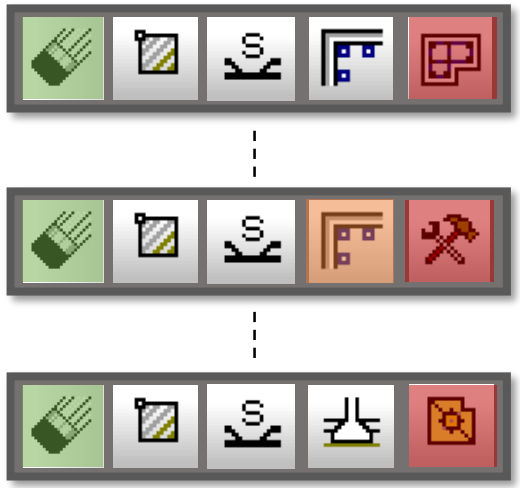
17.40%



`OPT(GA)`

N best commands
always available on a toolbar
a stochastic Genetic algorithm.

17.40%



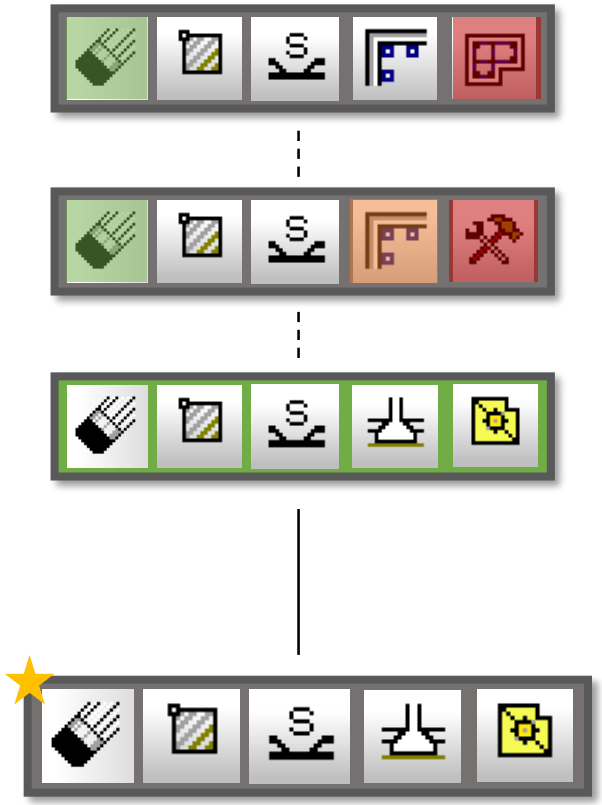
OPT(GA)

N best commands
always available on a toolbar
a stochastic Genetic algorithm.

17.40%

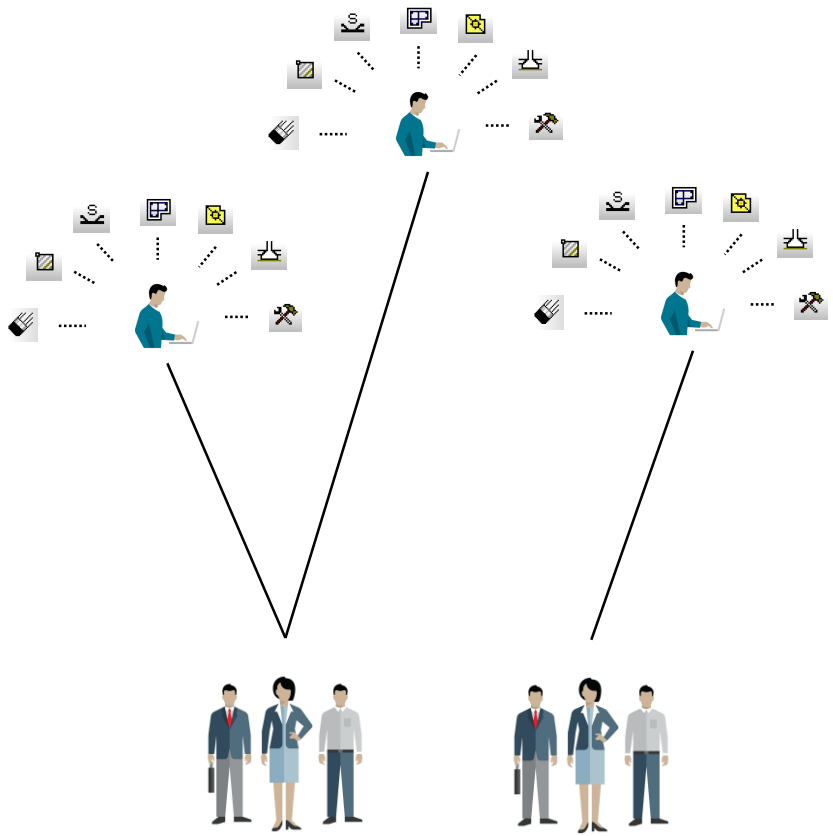
OPT(GA)

N best commands
always available on a toolbar
a stochastic Genetic algorithm.



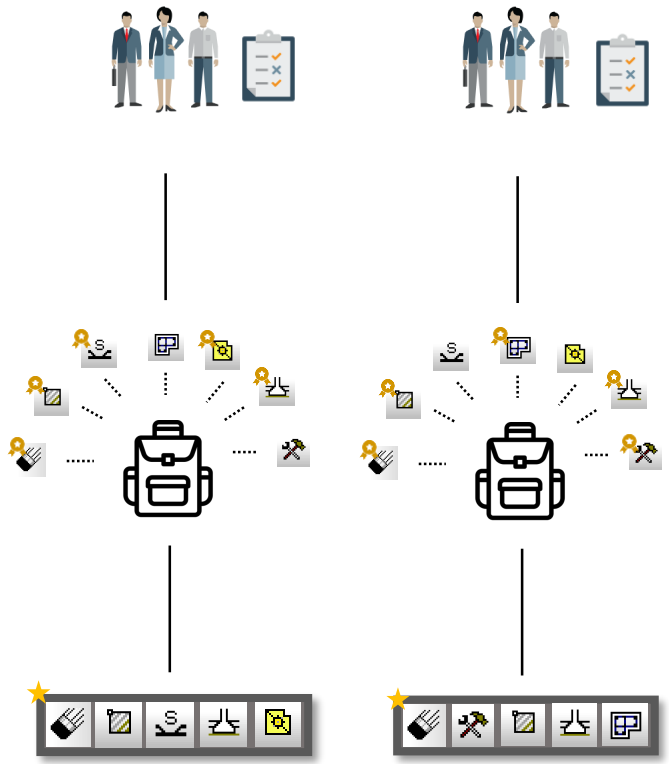
CLUSTER

Make clusters $(kmeans)$ *of users*
Run OPT(KS) for each cluster
Show best N *commands to each*



CLUSTER

Make clusters $(kmeans)$ *of users*
Run OPT(KS) for each cluster
Show best N *commands to each*



CLUSTER

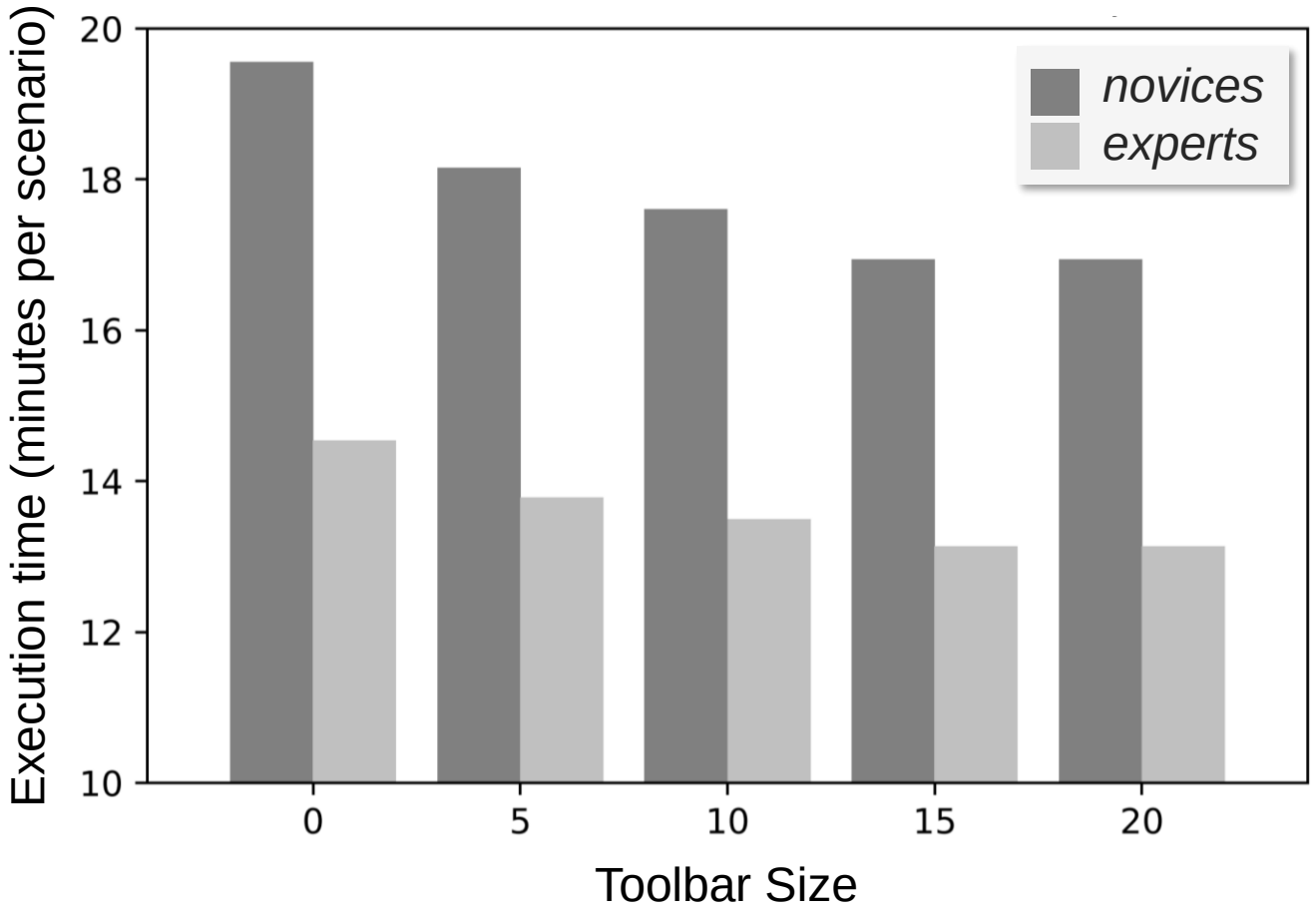
Make clusters $(kmeans)$ *of users*
Run OPT(KS) for each cluster
Show best N *commands to each*

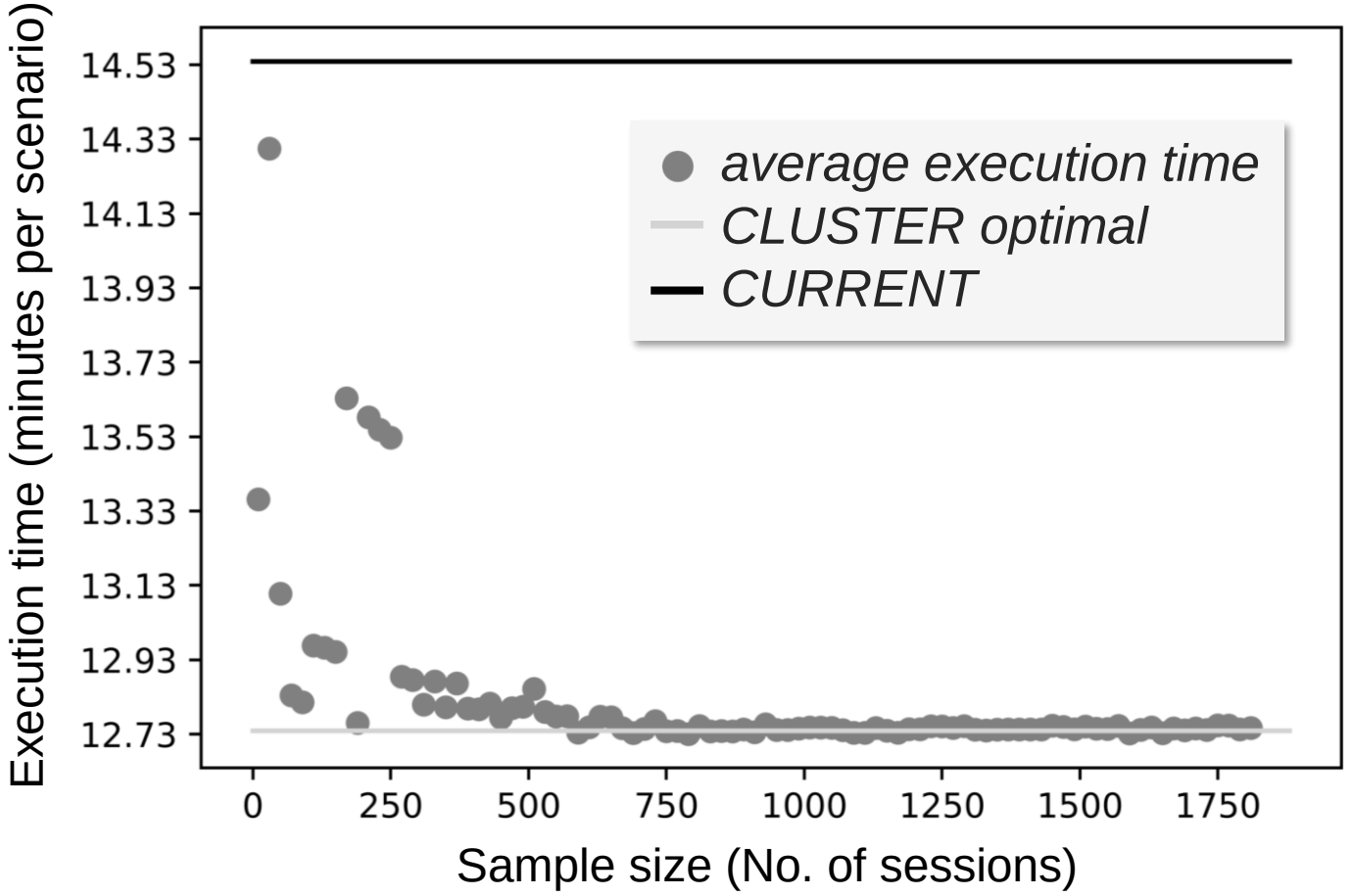
17.43%

Results

Method	Novices	Time (s)
ALL	18.5%	-
GROUP	0.6%	-
NAIVE	13.2%	7.8
MRU-B	10.4%	74.2
MRU-O	13.5%	1.2*
OPT(KS)	17.43%	1,946
OPT(GA)	17.40%	19,749*
CLUSTER	17.43%	2035

good
optimal
bad


Execution time (minutes per scenario)
20
18
16
14
12
10
0
5
10
15
20
Toolbar Size
novices
experts



Alexander Lattas, Imperial College London | Diomidis Spinellis, Athens University of Economics and Business

Command Grouping

GUI optimization
systemization

CLUSTER

15

× 500

Thank you!

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