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# Supplementary Materials of CADMorph: Geometry-Driven Parametric CAD Editing via a Plan–Generate–Verify Loop

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## A Outline

This supplementary material will cover the following aspects in addition to the main paper. It will cover the following aspects.

- Justification about using voxelized tSDFs for 3D data representation.
- More detailed qualitative results.
- The method to draw Figure 3 in the main paper.
- Analysis of inference time between different methods.
- Full prompts of experiments on GPT-series.
- An illustrative visualization of the iterative editing process.
- Discussion on failure cases.
- More details of human evaluation.
- Broader Impact.

## B Why CADMorph Uses a Voxel-Based Truncated SDF (tSDF)

**Boundary fidelity over appearance.** A CAD construction sequence encodes an object solely through the precise, watertight *surface* produced by sketches and extrusions. Representations that are (i) only *approximate* (e.g. point clouds, Gaussian splats) or (ii) *view-conditioned* (e.g. NeRF) inject non-geometric signals (texture, lighting) that CAD editing neither requires nor exploits. A geometry-centric format is therefore mandatory.

**Compatibility with convolutional attention.** Among geometry-centric formats, the contenders are meshes and voxels. CADMorph inspects cross-attention maps inside a 3-D U-Net based transformer, mirroring how 2-D diffusion models align pixels with text. This inspection demands a *regular grid* so that sliding convolutions capture spatial correlations—an assumption satisfied by voxels but violated by irregular meshes. Within voxel grids, a binary occupancy field provides only inside/outside signals, whereas a **truncated signed-distance field (tSDF)** additionally offers signed distance, furnishing sub-voxel geometric detail and richer gradients for learning.

**Boolean algebra and extensibility.** CAD solids arise from Boolean combinations of sketch–extrusion primitives. SDFs support these combinations analytically:

$$f_{A \cup B}(\mathbf{x}) = \min(f_A(\mathbf{x}), f_B(\mathbf{x})), \quad (1)$$

$$f_{A \setminus B}(\mathbf{x}) = \max(f_A(\mathbf{x}), -f_B(\mathbf{x})), \quad (2)$$

$$f_{A \cap B}(\mathbf{x}) = \max(f_A(\mathbf{x}), f_B(\mathbf{x})). \quad (3)$$

Because Eqs. (1)–(3) are differentiable and grid-aligned, CADMorph can *compose* or *extend* primitive sequences by operating directly on their tSDFs—a capability we plan to exploit for more intricate construction sequences in future work.

In this sense, voxelized tSDFs strike the best balance: exact boundary geometry, seamless integration with convolutional attention, and elegant Boolean composition. These properties make tSDFs the natural choice for CADMorph.

## C More Qualitative Results.

In this section we will put forward more qualitative results. The revised construction sequences, along with their renderings, are shown from Figure 5 to Figure 28. From the figures we can discover that *all* methods are able to produce grammatically coherent construction sequences, but the modality gap between the construction sequence and the corresponding geometric shape introduces a huge deviation between the rendered result and the target shape, thus calling for a specially-designed geometric module that brings the corresponding geometric information explicitly to the generated construction sequences.

## D Method to Draw the Cross-attention Map.

In this section we briefly illustrate how to project the cross-attention map onto the retrieved mesh of the tSDF. We first follow the practice in prompt-to-prompt to obtain the cross-attention map of the LDM in the DDIM inversion process.

Then the attention map is averaged and reshaped into the same size as the shape latent  $z$ , and linearly interpolated into the unit 3D voxel space afterwards. The interpolated attention score for each token is then projected onto the derived mesh vertices of the SDF.

For all the projected SDF scores, we then apply a low-pass filter and only remains the top 10% of them. Finally, on the vertices where no points remain, we further perform an 8 nearest-neighbor search and assign its value as the average of the values via inverse distance weighting.

## E Inference Time Cost.

In this section, we compare the time costs of various editing methods. As shown in Table 1, our method, CADMorph, requires several minutes to edit a single example. This time cost is consistent with other recent 3D generation and editing methods that combine diffusion-based models with per-shape optimization [Poole et al., 2022, Lin et al., 2023, Liu et al., 2023, Sun et al., 2024, Yi et al., 2024, Haque et al., 2023, Fang et al., 2024, Wu et al., 2024]. Although CADMorph seems to be slower than purely feedforward approaches or LLM-based API calls, this is expected given its reliance on diffusion processes, LLMs and iterative optimization strategies. The observed latency reflects the trade-off between performance and computational overhead inherent in such hybrid frameworks.

To evaluate time efficiency more comprehensively, we report both the elapsed time via API usage and the raw inference time on the official ChatGPT interface for methods involving closed-source LLMs. Notably, the o4-mini and o4-mini-high variants show longer elapsed times, which we attribute partially to possible queuing delays in the API service. To validate this, we tested ten samples using the official ChatGPT interface (<https://chatgpt.com/>), where we measured the average inference time excluding API latency. The results confirm that while queuing introduces some overhead, the primary time consumption originates from the visual reasoning process itself. In particular, these models often perform iterative inspection of multi-view inputs, leading to increased computation time. In comparison, CADMorph’s total elapsed time is only about 20% longer than GPT-based reasoning variants, while offering improved editing performance. This suggests a favorable trade-off between runtime and quality, especially when compared to feedforward models such as CAD-Diffuser and FlexCAD, which are limited in their ability to exploit additional test-time computation for better performance.

Table 1: Time usage for different editing methods. we report both the average elapsed time on the apis and the inference time on the official web interface for methods using closed source LLMs, as apis may be affected by congestions. The methods that are run locally remain the same time usage in the two criteria.

Method	Elapse Time (Minutes)↓	Inferece Time (Minutes)↓
<i>Feedforward methods.</i>		
CAD-Diffuser	0.18	0.18
FlexCAD	0.13	0.13
<i>Methods Using closed-source LLMs. (Approximation)</i>		
GPT-4o	1.27	1.07
o4-mini	5.36	3.24
o4-mini-high	6.02	5.32
<i>Our method.</i>		
<b>CADMorph</b>	7.26	7.26

## 76 F Full prompts of experiments on GPT-series.

77 We follow the same prompting method for the comparison experiments on GPT-4o, o4-mini and  
78 o4-mini-high. The prompts are listed in Listing 1. In practice, the image stacks four different views  
79 of the target geometric shape.

Listing 1: Prompts used in comparative experiments in GPT-4o, o4-mini, and o4-mini-high. The prompt first tells the exact rules of writing the construction sequences of a CAD model, then both the original parametric sequence and the target geometric shape are given to the model.

```

80 {
81 Input: original_param_seq, rendered_img_of_stacked_mult_views
82 prompt0 = ""
83 Below is a CAD file encoded into a structuralized text. The grammar of the CAD file
84 is as follows.
85 Carefully read the below grammar, try to understand the structuralized text and
86 render it in your heart.
87 A CAD file consists of several sketch and extrusion pairs.
88 A sketch consists of several loops with [SOL] resembling the start of a loop.
89 Each loop consists of several primitives which could be lines, arcs or circles with
90 their corresponding parameters.
91 For a line, its corresponding parameters are the 2D cordinates of its endpoint.
92 For a circle, its corresponding parameters are the 2D cordinates of its heart and
93 its radius.
94 For an arc, its corresponding parameters are the 2D cordinates of its endpoint, its
95 sweep angle and a flag showing whether it is counterclockwise.
96 Extrusion also has its parameters, which resembles the 3D sketch plane orientation,
97 the xyz origin in the 3D sketch plane, its scale of associated sketch profile,its
98 extrude distances toward both sides, the type of boolens operation between the it
99 and the privious sketch-extrusion pair, and the type of the extrusion.
100 Each sketch-extrusion pair is followed by a [SEP] token, and an [EOS] token at the
101 end of the construction sequence.
102 Note that for all the parameters which does not reflect the relationships, they are
103 normalized and quantized into 256 bins.
104 ""
105 prompt1 = ""
106 Use what you get from the structuralized text shown above,carefully read this image,
107 which is a multi-view rendering of a CAD model, modify the structuralized text so
108 that it corresponds to the given image. Think step by step before answering.
109 ""
110 prompt2 = ""
111 Remove all the unnecessary words in your response and give me the modifiled CAD file
112 using the format given above.
113 ""
114 user_prompt_1 = prompt0 + "\n" + original_param_seq + "\n" + prompt1 \

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116     + load_image_to_base64_url(rendered_img_of_stacked_mult_views)
117 user_prompt_2 = prompt2
118 }

```

120 The user\_prompt\_2 is given to GPTs after user\_prompt\_1 is responded, where user\_prompt\_1,  
121 response\_1 and user\_prompt\_2 are sent to GPT altogether.

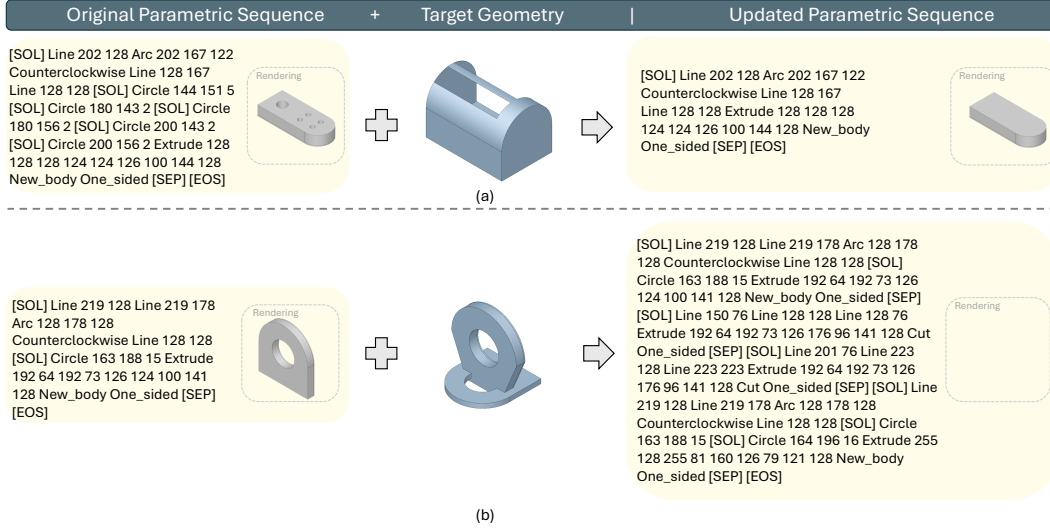


Figure 1: Some typical failure cases. The rendering left blank means the sequence id not able to render visible shapes.

## 122 G Visualization of the editing process.

123 In this section we put forward some illustrative examples on the visualization of the editing process  
124 via peeking the renderings of all the shapes in the queue in different turns. From Figure 4(a), we  
125 can discover that the parametric sequence quickly saturates to the right modification when the edit is  
126 easy. From Figure 4(b), we can discover that when the modification is hard to complete, the queue is  
127 slowly updated, namely, each iteration of CADMorph slowly changed the construction sequence to  
128 better fit the shape. It is also worth noting that in some cases, the queue remains stagnant, thereby  
129 showing the importance of the queue, which prevents the model from changing for the worse.

## 130 H Failure Cases.

131 In this section we put forward some failure cases. Despite the case discussed for the bottom example  
132 of Figure 6 of the main paper where CADMorph shows a certain robustness to inaccurate shape given,  
133 here we put some more representative failure cases.

134 Some typical failure cases are shown in Figure 1. From Figure 1(a) we can discover that CADMorph  
135 successfully removes the hole but stops at somewhere in the middle, as it fails to propose a mechanism  
136 that can bore the empty space in the middle of the arch while remaining the bar at the top, which is also  
137 quite challenging for experienced human designers. Another example is shown at Figure 1(b). The  
138 construction sequence shows that CADMorph tried to reuse the given shape and cut the unnecessary  
139 parts out. However, it turns out that the edited construction sequence fails to render a valid shape. We  
140 hypothesize that the reason might be an error in the CAD kernel, thereby showing that the MPP model  
141 still needs to acquire knowledge about the topology of CAD shapes and the rendering mechanism of  
142 the CAD kernel, which we leave as future work.

## 143 I Details of Human Evaluation.

144 Here we put forward more details of Human Evaluations mentioned in the main paper. The cover of  
145 human evaluations and an example question is illustrated in Figure 2 and Figure 3 respectively.

## 146 J Broader Impact.

147 This paper propose CADMorph, an automatic CAD editing method driven by geometric guidance.  
148 The method could reduce the labor of human designers for manual shape modifications. However,  
149 the edited mechanical part may cause harm to the entire assembly if it is not thoroughly examined by  
150 human designers.

### User Study on the Quality of Edited CAD Construction Sequences under Different Methods

You are invited to answer this questionnaire. Your answer is of great importance to assess the quality of different CAD editing methods.

Below are the edited CAD construction sequences under 6 different methods. Would you please kindly rank the editing results on the editing quality.

For the sequence you think has the best editing quality, please rank 1. For the sequence you think has the worst editing quality, please rank 6.

Hint: If you have no idea about the editing quality, you can first look at the **rendering** of each method in the dashed box and **compare it with the target shape**, you can also read the *construction sequence* and compare it with *the sequence in the input line*. Give your overall ranking of all methods on a 50-50 basis of the two criteria.

Write your rankings in the boxes next to the results for each question.

Note: Each CAD sequence is in a flattened CSG tree format and is encoded as the following shows.

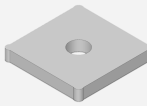
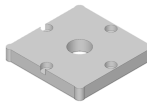


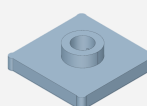

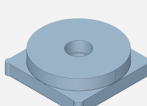

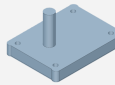



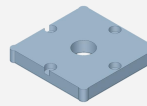

Commands	Parameters
(SOL)	$\emptyset$
L (Line)	$x, y$ : line end-point
A (Arc)	$x, y$ : arc end-point $\alpha$ : sweep angle $f$ : counter-clockwise flag
R (Circle)	$x, y$ : center $r$ : radius
E (Extrude)	$\theta, \phi, \gamma$ : sketch plane orientation $p_x, p_y, p_z$ : sketch plane origin $s$ : scale of associated sketch profile $e_1, e_2$ : extrude distances toward both sides $b$ : boolean type, $u$ : extrude type
(EOS)	$\emptyset$

Table 1. CAD commands and their parameters. (SOL) indicates the start of a loop; (EOS) indicates the end of the whole sequence.



[SOL] Circle 176 128 48 Extrude  
128 128 128 32 159 127 105 164  
128 New\_body One\_sided [SEP]  
[SOL] Line 223 128 Line 223 223  
Line 128 223 Line 128 128  
Extrude 128 128 128 88 86 163  
69 152 128 New\_body  
One\_sided [SEP] [EOS]

Figure 2: The cover of the user study.

<p>[SOL] Arc 134 122 128 Clockwise Line 216 122 Arc 222 128 154  Counterclockwise Line 222 210 Arc 216 216 52 Counterclockwise Line 134  216 Arc 128 210 102 Counterclockwise Line 128 128 [SOL] Circle 169 174 8  Extrude 128 128 128 47 58 127 150 150 128 New_body One_sided [SEP] [SOL]  Circle 176 128 48 [SOL] Circle 200 104 13 Extrude 128 128 128 32 159 149  105 150 128 New_body One_sided [SEP] [EOS]</p>		Input
		Target Shape
<p>[SOL] Circle 176 128 48 Extrude 128 128 128 32 159 127 105 164  128 New_body One_sided [SEP] [SOL] Line 223 128 Line 223 223  Line 128 223 Line 128 128 Extrude 128 128 128 88 86 163 69 152  128 New_body One_sided [SEP] [EOS]</p>		
<p>[SOL] Arc 134 122 128 Clockwise Line 216 122 Arc 222 128 154  Counterclockwise Line 222 210 Arc 216 216 52 Counterclockwise Line 134  216 Arc 128 210 102 Counterclockwise Line 128 128 [SOL] Circle 169 174 8  Extrude 128 128 128 34 46 127 174 153 128 New_body One_sided [SEP]  [SOL] Circle 176 128 48 [SOL] Circle 189 114 28 Extrude 128 128 128 79 140  127 50 178 128 New_body One_sided [SEP] [EOS]</p>		
<p>[SOL] Arc 134 122 128 Clockwise Line 216 122 Arc 222 128 154  Counterclockwise Line 222 210 Arc 216 216 52 Counterclockwise Line 134  216 Arc 128 210 102 Counterclockwise Line 128 128 [SOL] Circle 169 174 8  Extrude 128 128 128 47 58 127 150 150 128 New_body One_sided [SEP] [SOL]  Circle 176 128 48 [SOL] Circle 200 104 13 Extrude 128 128 128 32 159 149  105 150 128 New_body One_sided [SEP] [EOS]</p>		
<p>[SOL] Arc 136 124 90 Clockwise Line 195 124 Arc 202 128 89  Clockwise Line 202 216 Arc 195 222 154 Clockwise Line 136 222 Arc  128 216 102 Counterclockwise Line 128 128 [SOL] Circle 137 213 2  [SOL] Circle 137 134 2 [SOL] Circle 191 134 2 [SOL] Circle 191 213 2  Extrude 128 128 128 69 40 127 160 151 128 New_body One_sided  [SEP] [SOL] Circle 176 128 48 Extrude 128 128 128 112 90 127 16  219 128 New_body One_sided [SEP] [EOS]</p>		
<p>[SOL] Line 223 128 Line 223 223 Line 128 223 Line 128 128 Extrude  128 128 128 80 80 126 82 187 128 New_body One_sided [SEP] [SOL]  Circle 176 128 48 Extrude 128 128 128 89 135 185 39 168 128  New_body One_sided [SEP] [EOS]</p>		
<p>[SOL] Arc 134 122 128 Clockwise Line 216 122 Arc 222 128 154  Counterclockwise Line 222 210 Arc 216 216 52 Counterclockwise  Line 134 216 Arc 128 210 102 Counterclockwise Line 128 128 [SOL]  Circle 169 174 8 Extrude 128 128 128 34 46 127 174 153 128  New_body One_sided [SEP] [SOL] Circle 176 128 47 Extrude 128 128  128 32 127 152 15 117 128 Cut One_sided [SEP] [SOL] Circle 176  128 48 Extrude 128 128 128 107 200 152 15 117 128 Cut One_sided  [SEP] [SOL] Circle 176 128 48 Extrude 128 128 128 107 49 152 15  117 128 Cut One_sided [SEP] [SOL] Circle 176 128 48 Extrude 128  128 128 183 127 152 15 117 128 Cut One_sided [SEP] [EOS]</p>		

(1)

Figure 3: An Example question in the human evaluation.

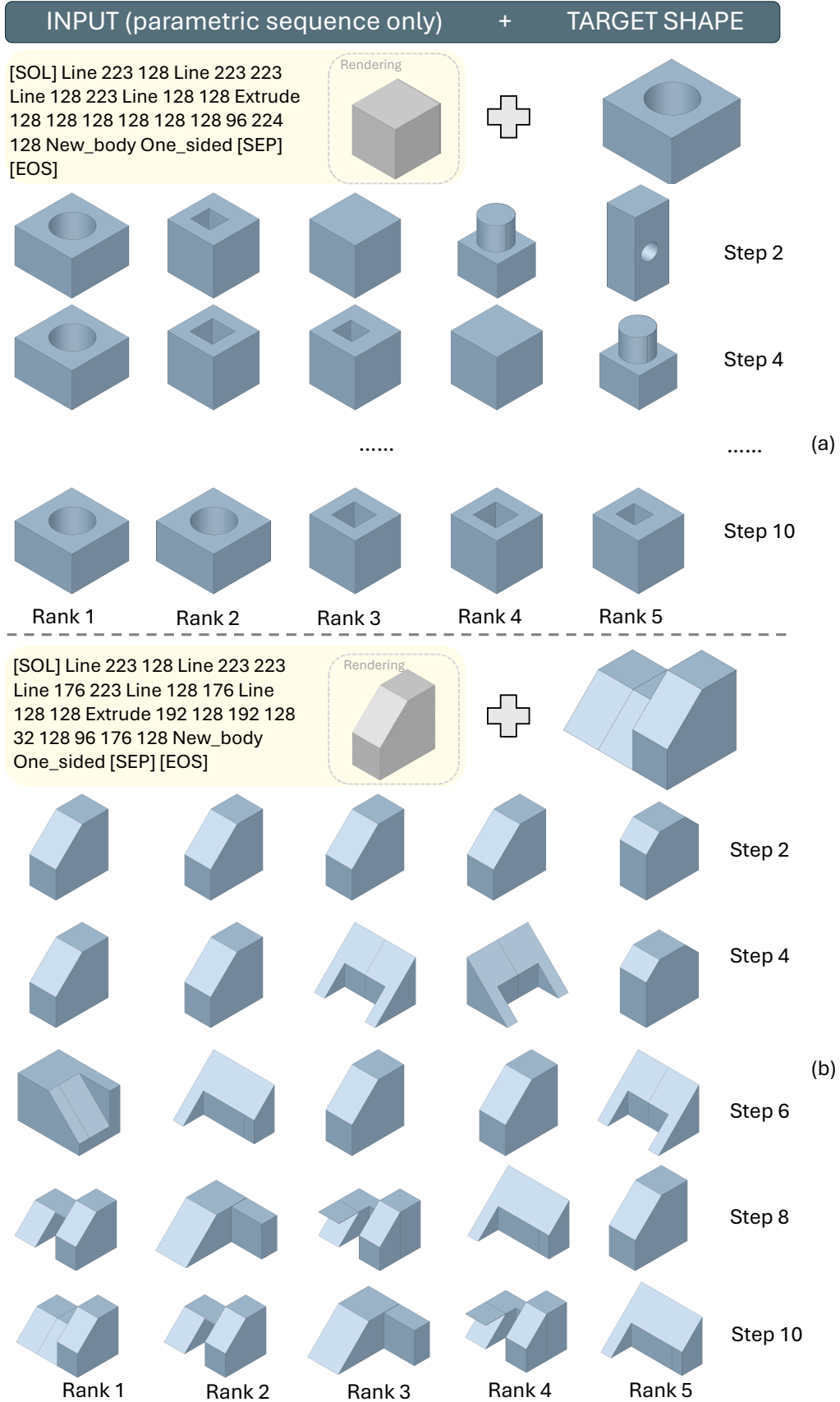
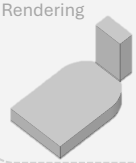

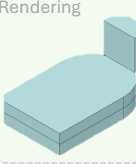
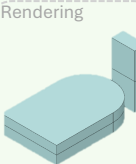
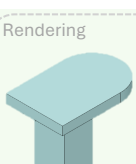
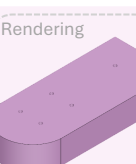
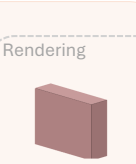
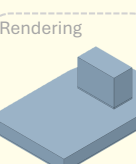


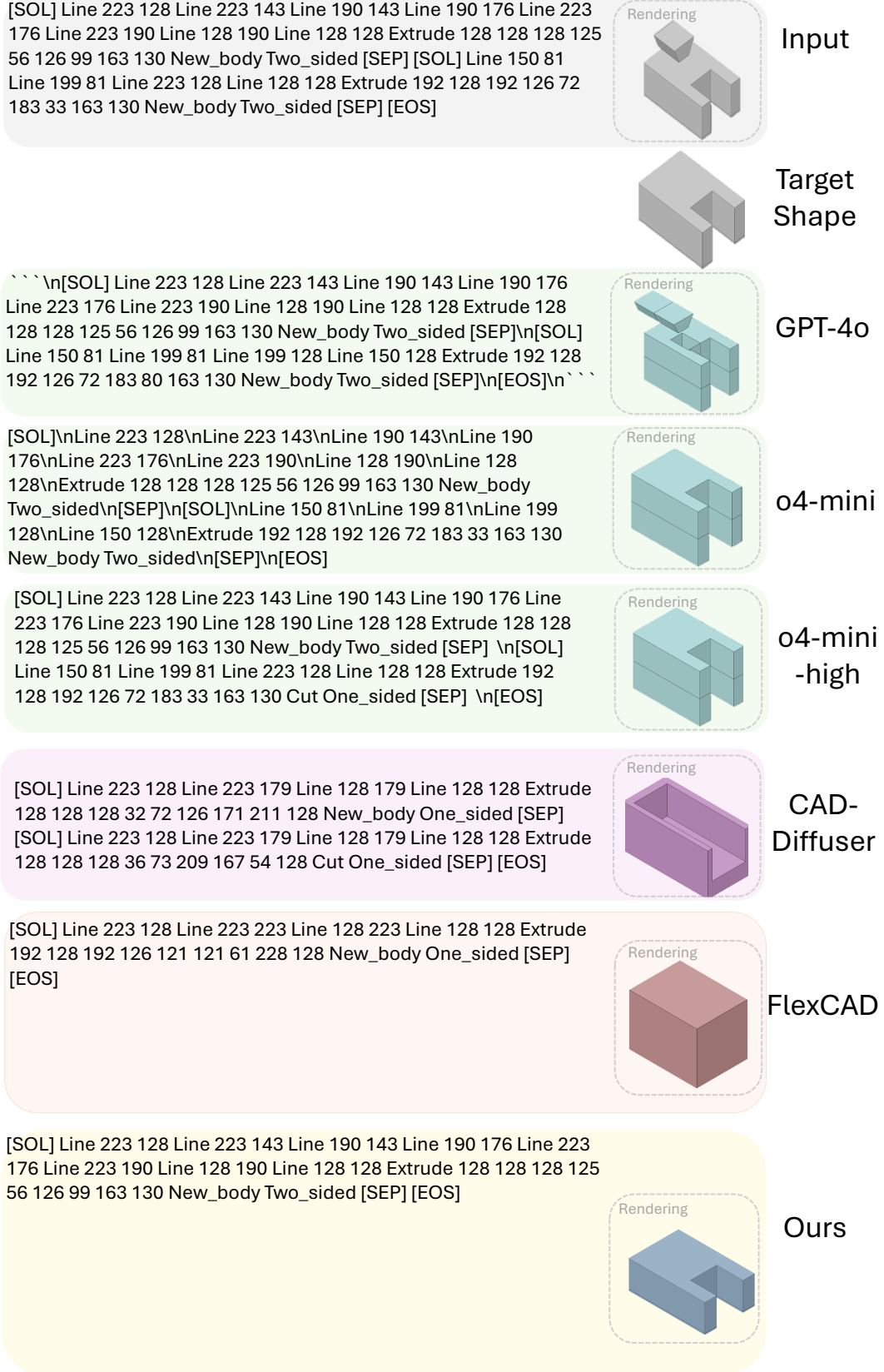
Figure 4: Visualization of the priority queue throughout the editing process. We sample every two editing iterations during the editing process. The queue remains not significantly changed is omitted by "..." for brevity.

<pre>[SOL] Line 190 128 Line 190 192 Arc 128 192 128 Counterclockwise Line 128 128 Extrude 128 128 128 79 79 127 130 141 129 New_body Two_sided [SEP] [SOL] Line 223 128 Line 223 176 Line 128 176 Line 128 128 Extrude 128 128 128 101 203 141 42 169 129 New_body Two_sided [SEP] [EOS]</pre>		Input
		Target Shape
<pre>```\n[SOL] Line 190 128 Line 190 192 Arc 128 192 128 Counterclockwise Line 128 128 \nExtrude 128 128 128 79 79 127 130 141 129 New_body Two_sided [SEP] \n[SOL] Line 223 128 Line 223 176 Line 128 176 Line 128 128 \nExtrude 128 128 128 101 203 141 42 169 129 Add Two_sided [SEP] [EOS]\n```\n</pre>		GPT-4o
<pre>[SOL] Line 190 128 Line 190 192 Arc 128 192 128 Counterclockwise Line 128 128 Extrude 128 128 128 79 79 127 130 141 129 New_body Two_sided [SEP]\n[SOL] Line 136 176 Line 136 216 Line 216 216 Line 216 176 Extrude 128 128 128 101 203 141 42 169 129 New_body Two_sided [SEP]\n[EOS]</pre>		o4-mini
<pre>[SOL] Line 190 128 Line 190 192 Arc 128 192 128 Counterclockwise Line 128 128 Extrude 128 128 128 79 79 127 130 141 129 New_body One_sided [SEP]\n[SOL] Line 144 144 Line 144 176 Line 176 176 Line 176 144 Extrude 128 128 128 79 79 127 130 48 0 Boolean_union One_sided [SEP]\n[EOS]</pre>		o4-mini-high
<pre>[[SOL] Line 202 128 Arc 202 167 122 Counterclockwise Line 128 167 Line 128 128 [SOL] Circle 144 151 5 [SOL] Circle 180 143 2 [SOL] Circle 180 156 2 [SOL] Circle 200 143 2 [SOL] Circle 200 156 2 Extrude 128 128 128 124 124 126 100 144 128 New_body One_sided [SEP] [SOL] Circle 176 128 47 Extrude 192 64 192 141 126 130 2 109 128 Cut One_sided [SEP] [EOS]</pre>		CAD-Diffuser
<pre>[SOL] Line 160 128 Line 160 223 Line 128 223 Line 128 128 Extrude 192 64 192 91 127 32 178 137 128 New_body One_sided [SEP] [SOL] Circle 176 128 48 Extrude 192 192 192 150 127 139 6 37 128 Cut One_sided [SEP] [EOS]</pre>		FlexCAD
<pre>[SOL] Line 190 128 Line 190 192 Arc 128 192 128 Counterclockwise Line 128 128 Extrude 128 128 128 70 71 126 153 143 130 New_body Two_sided [SEP] [SOL] Line 223 128 Line 223 176 Line 128 176 Line 128 128 Extrude 128 128 128 97 163 143 50 163 130 New_body Two_sided [SEP] [EOS]</pre>		Ours

(1)


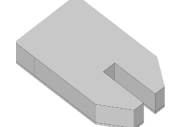

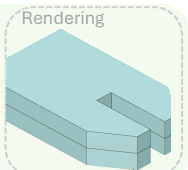
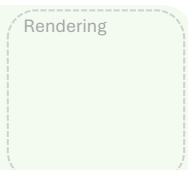
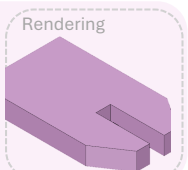
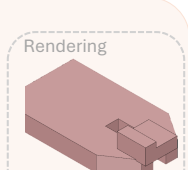
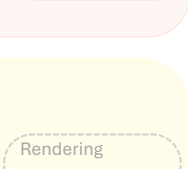
Figure 5: Full results of the original parametric sequence (with renderings), target shapes, and the edited sequence of different methods (with renderings). Blank represents not able to generate any sequence or the sequence is not able to render shapes after removing irrelevant characters. (1 of 24)





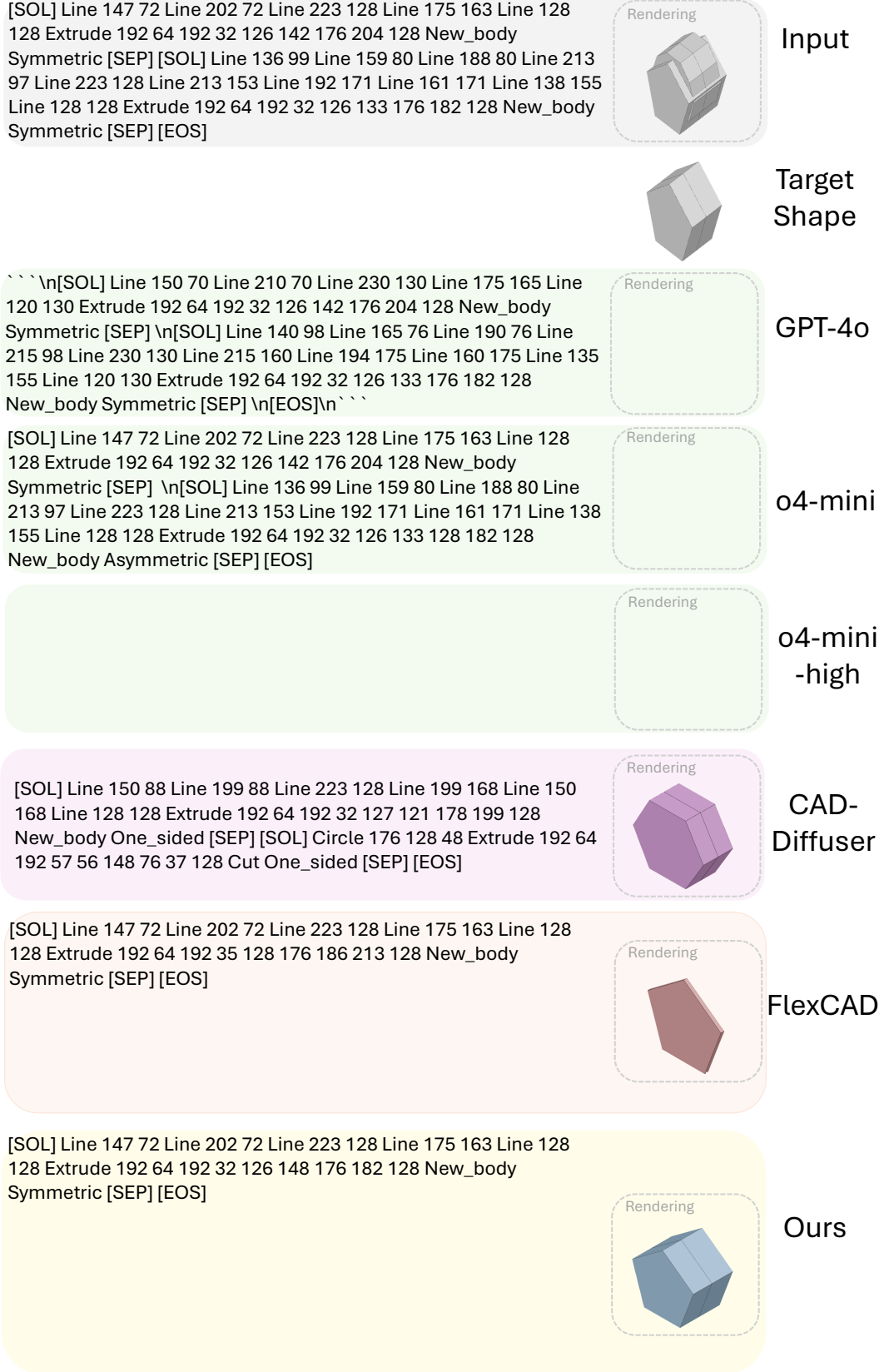
(2)

Figure 6: Full results of the original parametric sequence (with renderings), target shapes, and the edited sequence of different methods (with renderings). Blank represents not able to generate any sequence or the sequence is not able to render shapes after removing irrelevant characters. (2 of 24)

<p>[SOL] Line 146 128 Line 202 128 Line 223 142 Line 223 151 Line 186 151 Line 186 161 Line 223 161 Line 223 170 Line 202 184 Line 146 184 Line 128 184 Line 128 128 Extrude 128 128 128 32 121 127 116 141 129 New_body Two_sided [SEP] [SOL] Line 223 33 Line 223 128 Line 128 128 Extrude 128 128 128 52 202 141 92 127 128 Cut Symmetric [SEP] [EOS]</p>		Input
		Target Shape
<p>```\n[SOL] Line 146 128 Line 202 128 Line 223 142 Line 223 151 Line 186 151 Line 186 161 Line 223 161 Line 223 170 Line 202 184 Line 146 184 Line 128 184 Line 128 128 Extrude 128 128 128 32 121 127 116 141 129 New_body Two_sided [SEP] [SOL] Line 223 40 Line 201 40 Line 201 128 Line 128 128 Line 128 140 Line 170 140 Line 170 55 Line 223 55 Line 223 40 Extrude 128 128 128 50 202 141 92 127 128 Cut Symmetric [SEP] [EOS]\n```\n</p>		GPT-4o
<p>[SOL] Line 146 128 Line 202 128 Line 223 142 Line 223 151 Line 186 151 Line 186 161 Line 223 161 Line 223 170 Line 202 184 Line 146 184 Line 128 184 Line 128 128 Extrude 128 128 128 32 121 127 116 141 129 New_body Two_sided [SEP]\n[SOL] Line 170 140 Line 210 140 Line 210 160 Line 170 160 Extrude 128 128 128 32 121 127 116 0 40 Subtraction One_sided [SEP]\n[SOL] Line 188 132 Line 208 132 Line 208 145 Line 188 145 Extrude 128 128 128 32 121 127 116 0 20 Union One_sided [SEP] [EOS]</p>		o4-mini
<p>[SOL] Line 156 128 Line 202 128 Line 223 142 Line 223 151 Line 186 151 Line 186 161 Line 223 161 Line 223 170 Line 202 184 Line 156 184 Line 128 184 Line 128 128 Extrude 128 128 128 32 121 127 116 141 129 New_body Two_sided [SEP] [SOL] Line 223 33 Line 223 128 Line 156 128 Extrude 128 128 128 52 202 141 92 127 128 Cut Symmetric [SEP] [EOS]</p>		o4-mini-high
<p>[SOL] Line 146 128 Line 202 128 Line 223 142 Line 223 151 Line 186 151 Line 186 161 Line 223 161 Line 223 170 Line 202 184 Line 146 184 Line 128 184 Line 128 128 Extrude 128 128 128 32 121 127 116 141 129 New_body Two_sided [SEP] [EOS]</p>		CAD-Diffuser
<p>[SOL] Line 146 128 Line 202 128 Line 223 142 Line 223 151 Line 186 151 Line 186 161 Line 223 161 Line 223 170 Line 202 184 Line 146 184 Line 128 184 Line 128 128 Extrude 128 128 128 32 121 127 116 143 128 New_body One_sided [SEP] [SOL] Line 223 80 Line 223 223 Line 128 176 Line 128 128 Extrude 128 128 128 58 150 141 9 113 128 Cut One_sided [SEP] [EOS]</p>		FlexCAD
<p>[SOL] Line 146 128 Line 202 128 Line 223 142 Line 223 151 Line 186 151 Line 186 161 Line 223 161 Line 223 170 Line 202 184 Line 146 184 Line 128 184 Line 128 128 Extrude 128 128 128 32 121 127 116 141 129 New_body Two_sided [SEP] [EOS]</p>		Ours

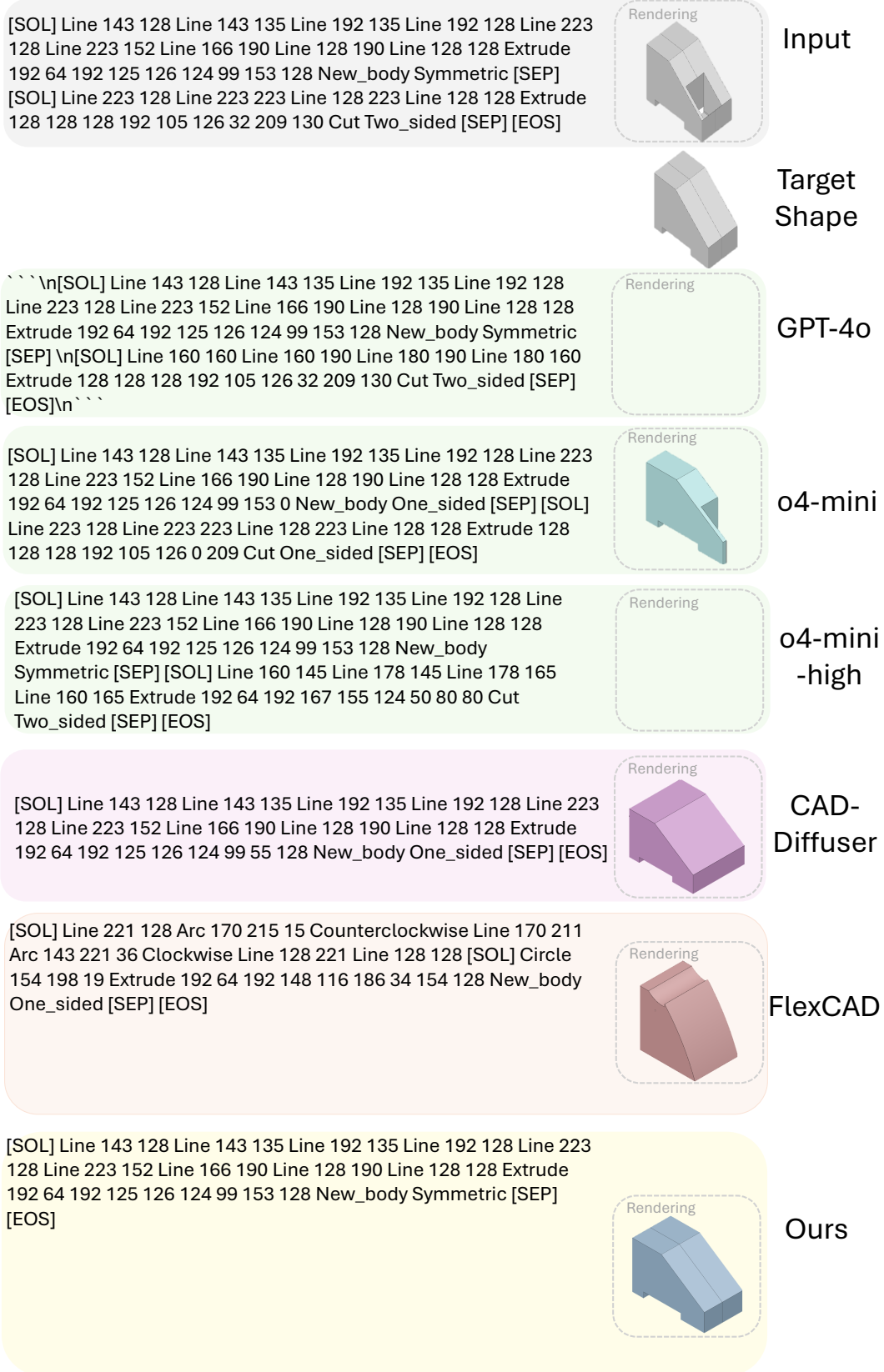
(3)

Figure 7: Full results of the original parametric sequence (with renderings), target shapes, and the edited sequence of different methods (with renderings). Blank represents not able to generate any sequence or the sequence is not able to render shapes after removing irrelevant characters. (3 of 24)



(4)

Figure 8: Full results of the original parametric sequence (with renderings), target shapes, and the edited sequence of different methods (with renderings). Blank represents not able to generate any sequence or the sequence is not able to render shapes after removing irrelevant characters. (4 of 24)



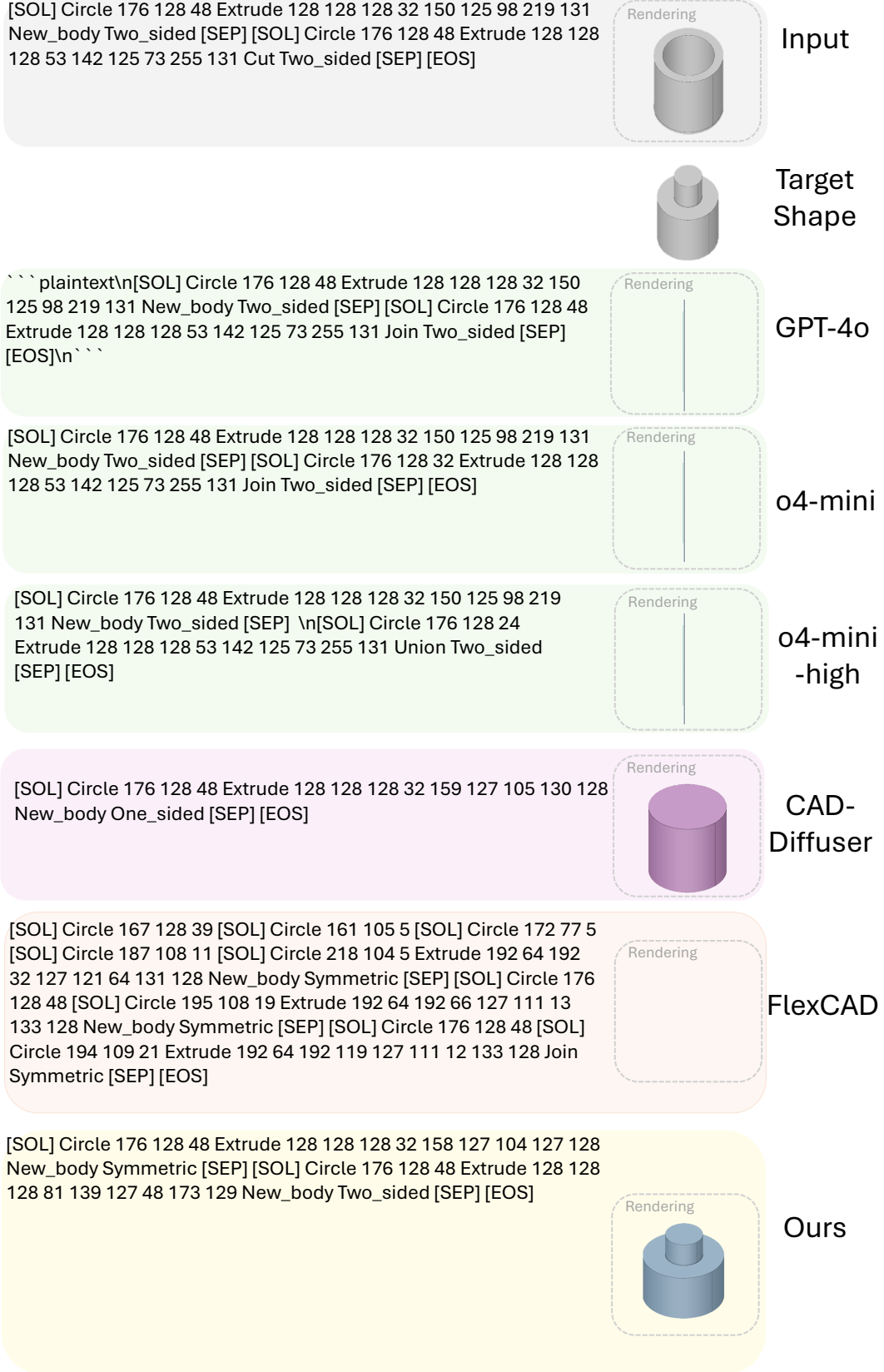
(5)

Figure 9: Full results of the original parametric sequence (with renderings), target shapes, and the edited sequence of different methods (with renderings). Blank represents not able to generate any sequence or the sequence is not able to render shapes after removing irrelevant characters. (5 of 24)



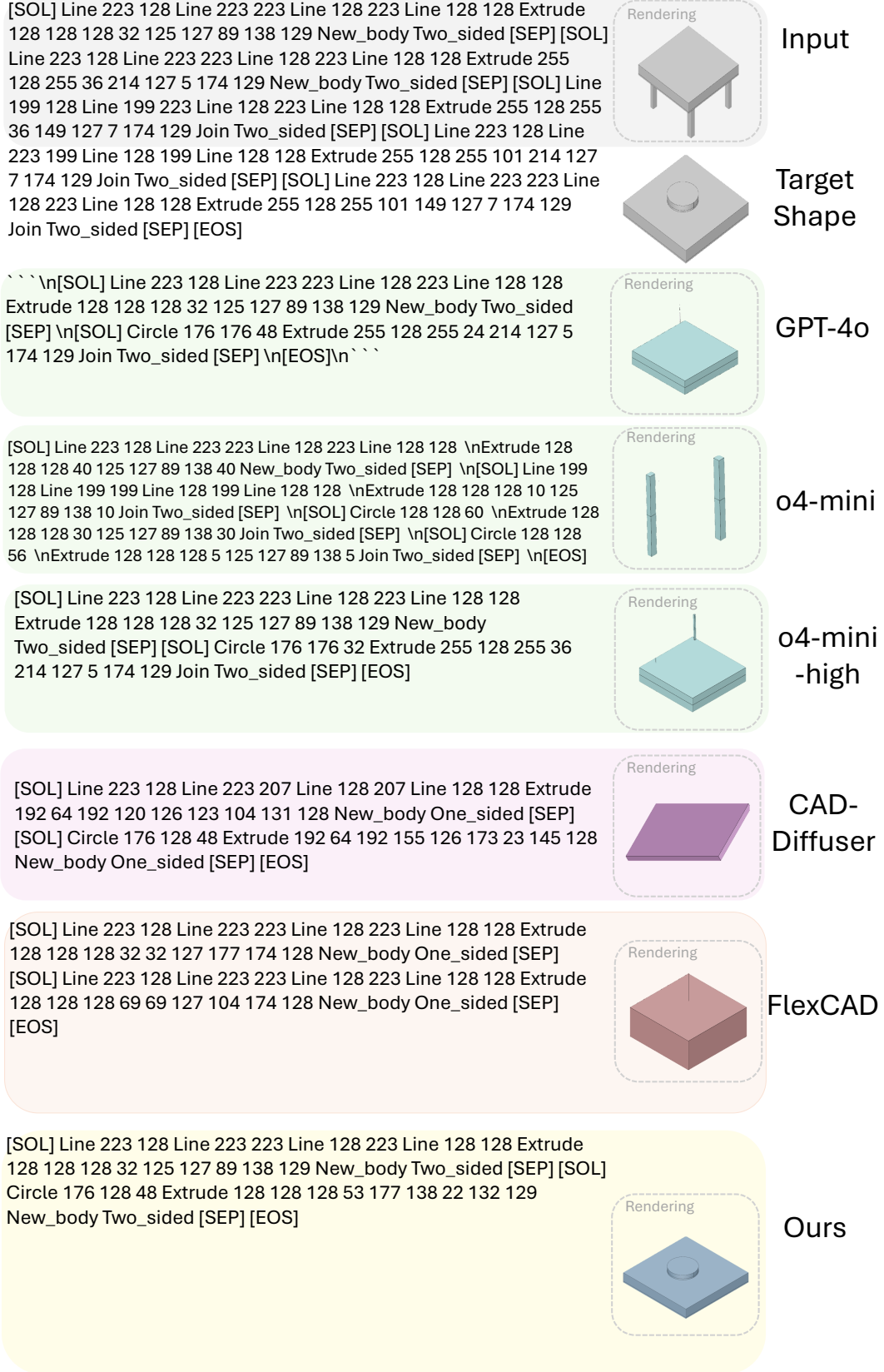
(6)

Figure 10: Full results of the original parametric sequence (with renderings), target shapes, and the edited sequence of different methods (with renderings). Blank represents not able to generate any sequence or the sequence is not able to render shapes after removing irrelevant characters. (6 of 24)



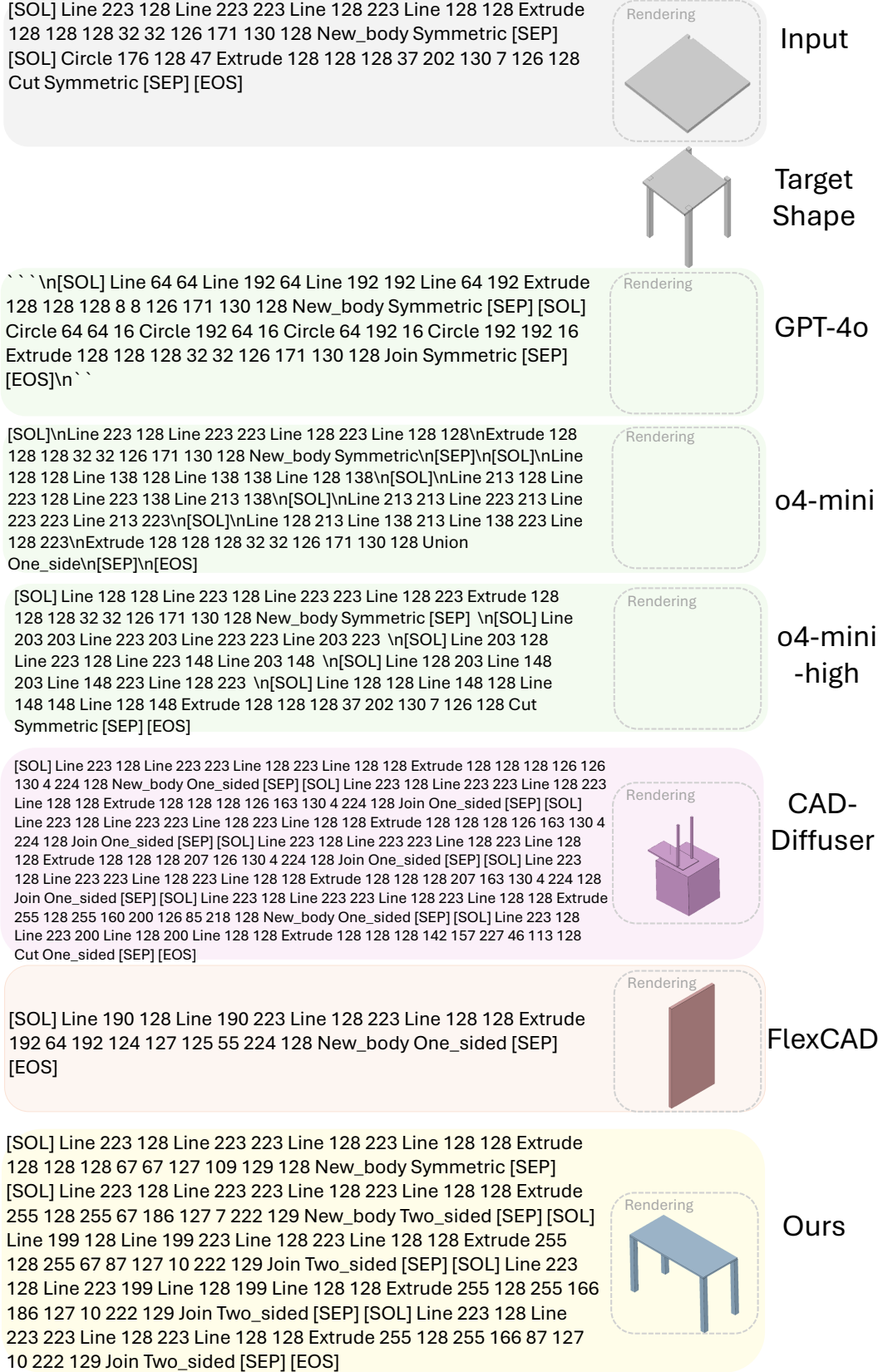
(7)

Figure 11: Full results of the original parametric sequence (with renderings), target shapes, and the edited sequence of different methods (with renderings). Blank represents not able to generate any sequence or the sequence is not able to render shapes after removing irrelevant characters. (7 of 24)



(8)

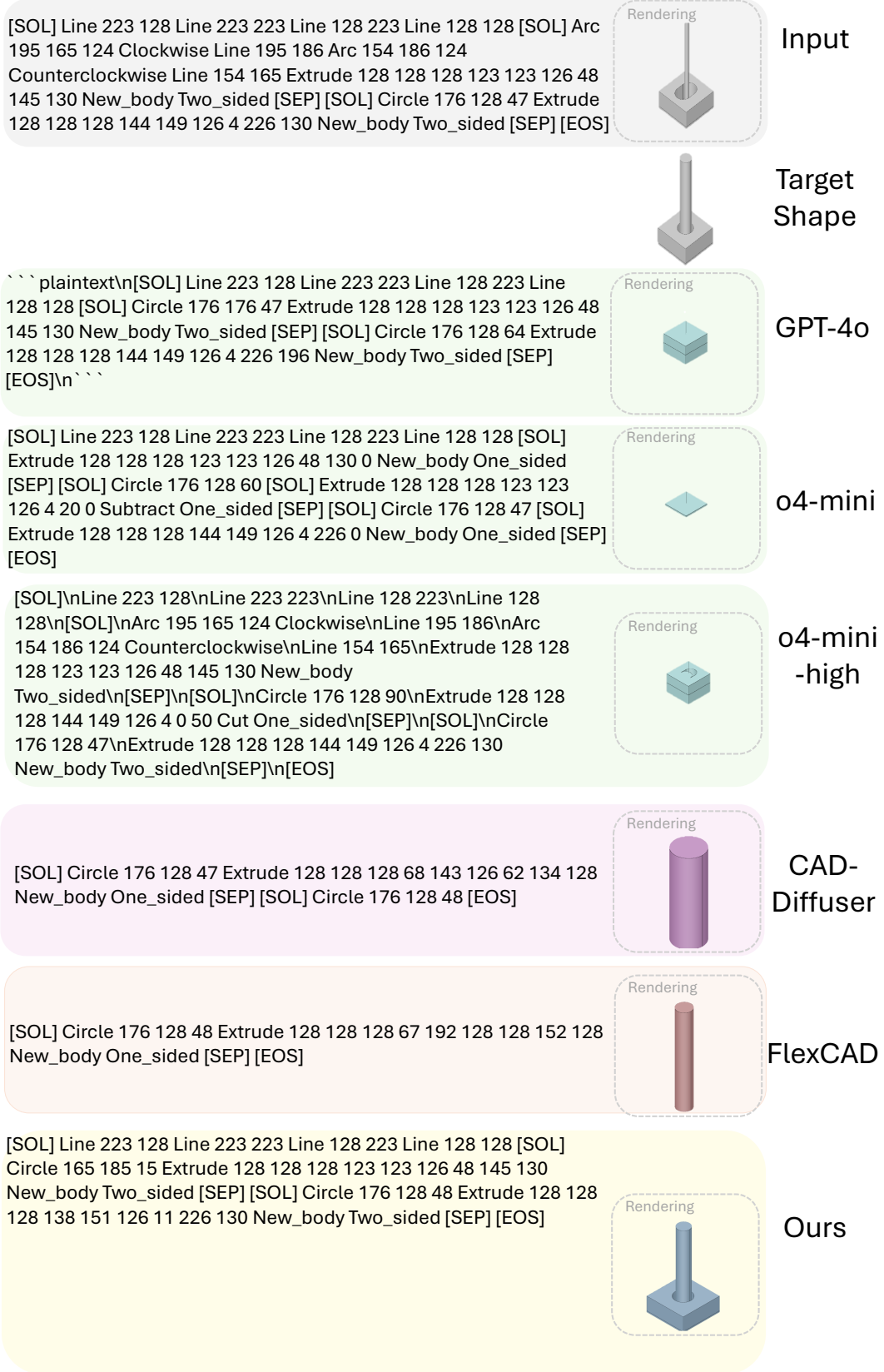
Figure 12: Full results of the original parametric sequence (with renderings), target shapes, and the edited sequence of different methods (with renderings). Blank represents not able to generate any sequence or the sequence is not able to render shapes after removing irrelevant characters. (8 of 24)



(9)

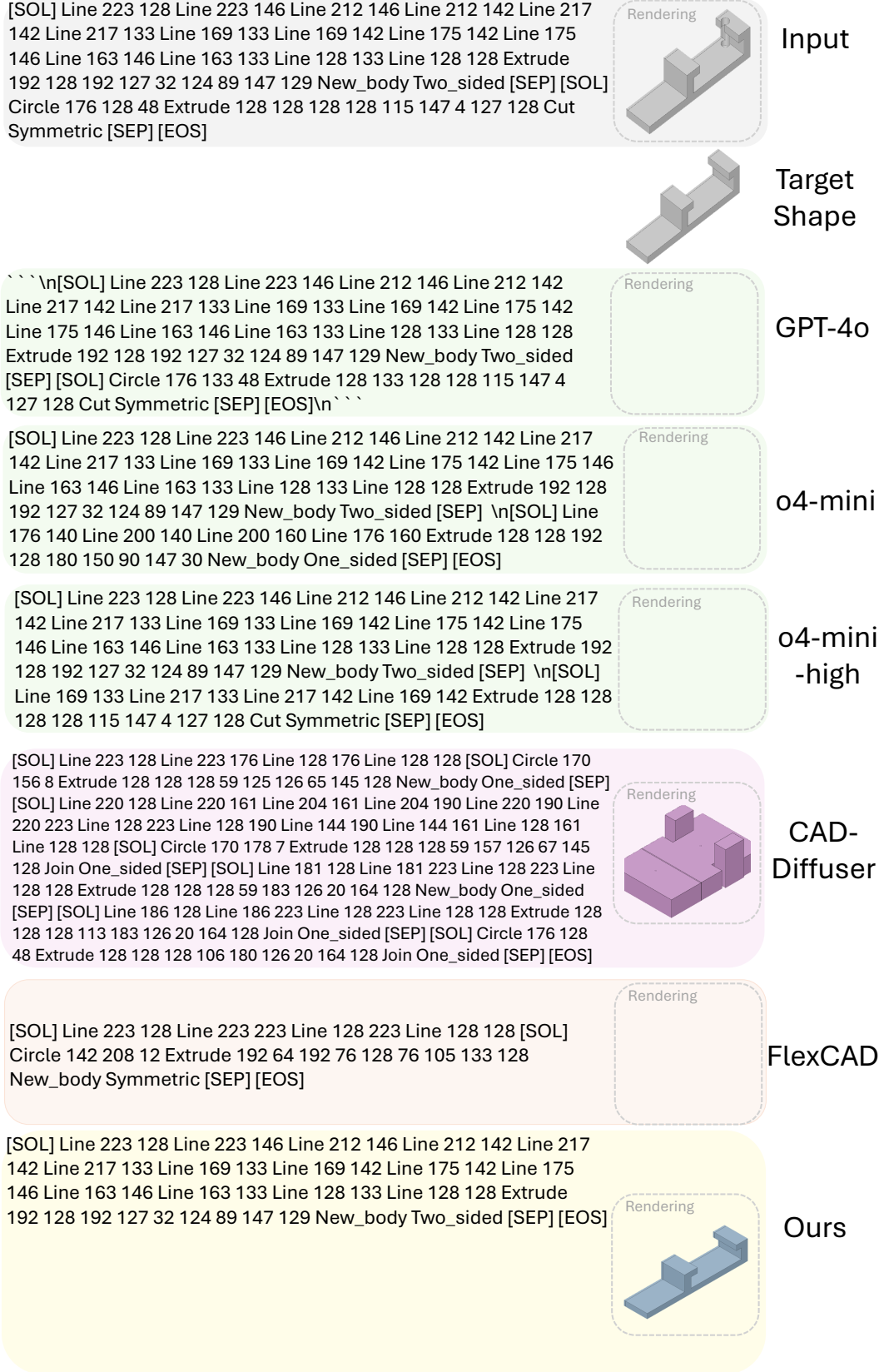
Figure 13: Full results of the original parametric sequence (with renderings), target shapes, and the edited sequence of different methods (with renderings). Blank represents not able to generate any sequence or the sequence is not able to render shapes after removing irrelevant characters. (9 of 24)





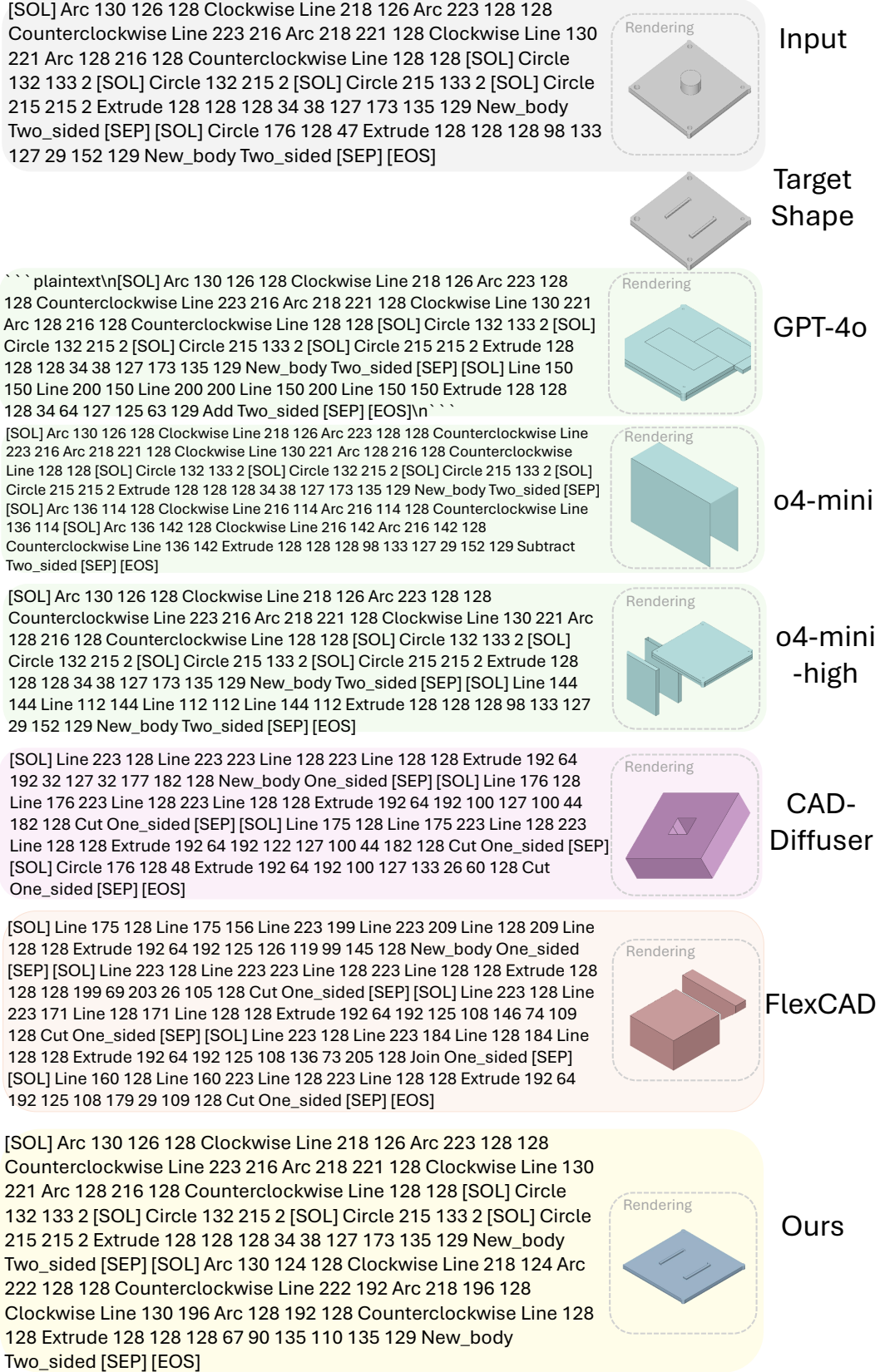
(10)

Figure 14: Full results of the original parametric sequence (with renderings), target shapes, and the edited sequence of different methods (with renderings). Blank represents not able to generate any sequence or the sequence is not able to render shapes after removing irrelevant characters. (10 of 24)





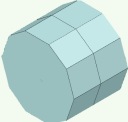
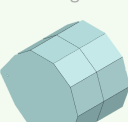
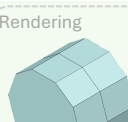
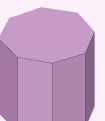

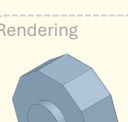
(11)

Figure 15: Full results of the original parametric sequence (with renderings), target shapes, and the edited sequence of different methods (with renderings). Blank represents not able to generate any sequence or the sequence is not able to render shapes after removing irrelevant characters. (11 of 24)




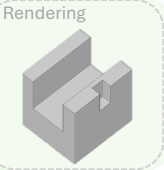

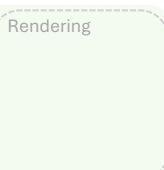
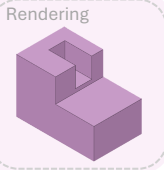
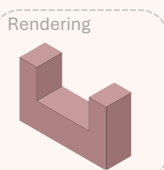
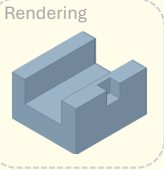
(12)

Figure 16: Full results of the original parametric sequence (with renderings), target shapes, and the edited sequence of different methods (with renderings). Blank represents not able to generate any sequence or the sequence is not able to render shapes after removing irrelevant characters. (12 of 24)

<p>[SOL] Line 138 99 Line 159 83 Line 190 83 Line 213 99 Line 223 128 Line 213 157 Line 190 173 Line 159 173 Line 138 157 Line 128 128 Extrude 192 64 192 32 127 121 178 194 129 New_body Two_sided [SEP] [EOS]</p>	<p>Rendering</p> 	<p>Input</p>
		<p>Target Shape</p>
<p>```\n[SOL] Line 138 99 Line 159 83 Line 190 83 Line 213 99 Line 223 128 Line 213 157 Line 190 173 Line 159 173 Line 138 157 Line 128 128 [SOL] Circle 180 128 40 Extrude 192 64 192 32 127 121 178 194 129 New_body Two_sided [SEP] [SOL] Circle 180 128 40 Extrude 192 64 192 32 127 121 178 194 129 Cut Two_sided [SEP] [EOS]\n```\n</p>	<p>Rendering</p> 	<p>GPT-4o</p>
<p>[SOL] Line 138 99 Line 159 83 Line 190 83 Line 213 99 Line 223 128 Line 213 157 Line 190 173 Line 159 173 Line 138 157 Line 128 128 Extrude 192 64 192 32 127 121 178 194 129 New_body Two_sided [SEP] [SOL] Circle 128 128 32 Extrude 192 64 192 32 127 121 178 194 129 Cut Two_sided [SEP] [EOS]</p>	<p>Rendering</p> 	<p>o4-mini</p>
<p>[SOL] Line 178 128 Line 163 163 Line 128 178 Line 93 163 Line 78 128 Line 93 93 Line 128 78 Line 163 93 [SOL] Circle 128 128 35 Extrude 192 64 192 32 127 121 178 194 129 New_body Two_sided [SEP] [EOS]</p>	<p>Rendering</p> 	<p>o4-mini-high</p>
<p>[SOL] Line 145 96 Line 180 87 Line 212 104 Line 223 139 Line 204 171 Line 169 182 Line 137 163 Line 128 128 Extrude 128 128 128 53 101 123 113 234 128 New_body One_sided [SEP] [SOL] Circle 176 128 48 Extrude 128 128 128 84 128 229 32 0 128 Cut One_sided [SEP] [EOS]</p>	<p>Rendering</p> 	<p>CAD-Diffuser</p>
<p>[SOL] Line 207 128 Line 207 136 Line 191 136 Line 191 223 Line 144 223 Line 144 136 Line 128 136 Line 128 128 Extrude 192 64 192 85 128 76 148 165 128 New_body One_sided [SEP] [EOS]</p>	<p>Rendering</p> 	<p>FlexCAD</p>
<p>[SOL] Line 138 99 Line 159 83 Line 190 83 Line 213 99 Line 223 128 Line 213 157 Line 190 173 Line 159 173 Line 138 157 Line 128 128 Extrude 192 64 192 32 127 121 178 194 129 New_body Two_sided [SEP] [SOL] Circle 176 128 48 Extrude 192 64 192 77 127 140 52 211 129 New_body Two_sided [SEP] [EOS]</p>	<p>Rendering</p> 	<p>Ours</p>

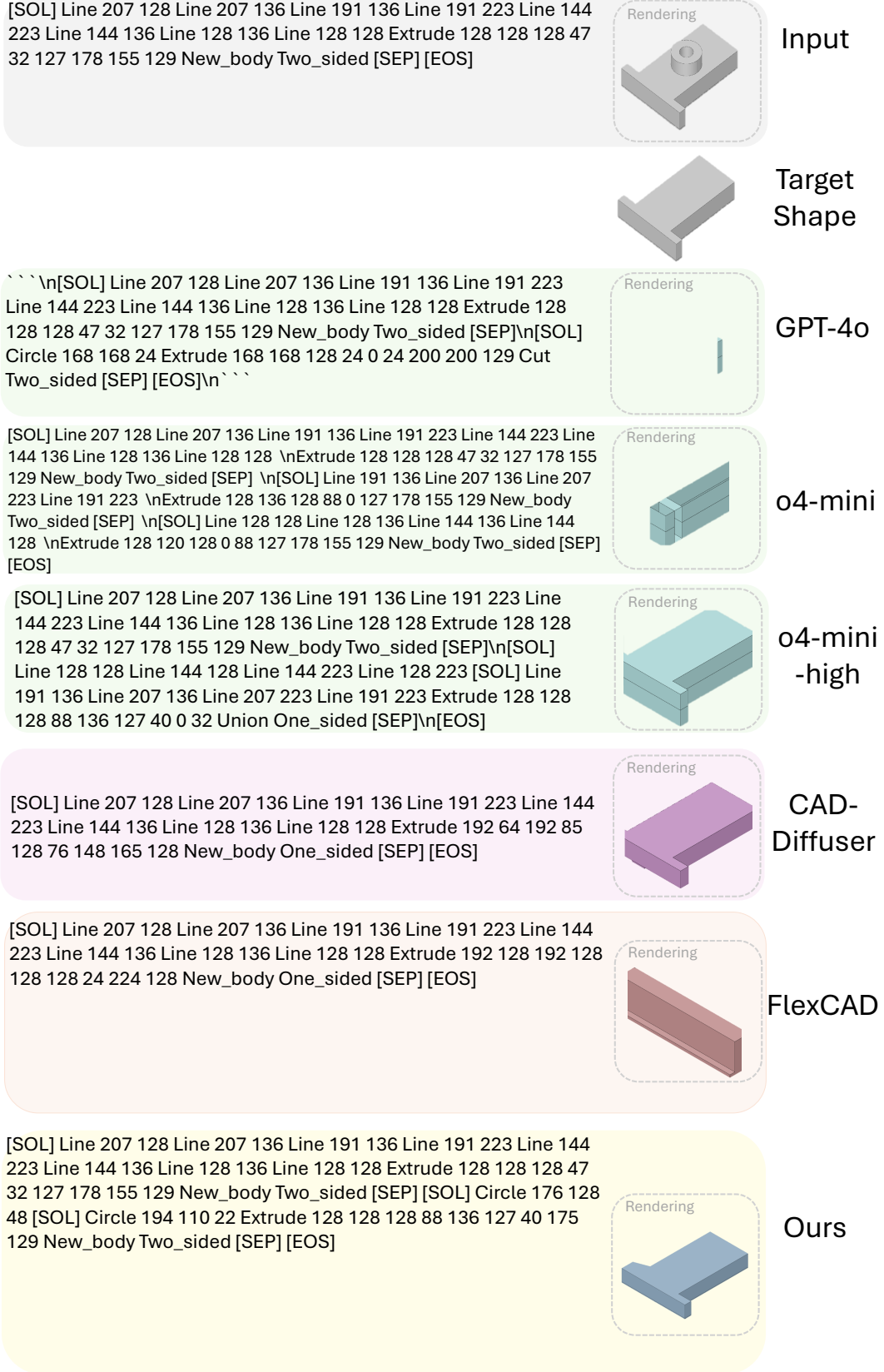
(13)

Figure 17: Full results of the original parametric sequence (with renderings), target shapes, and the edited sequence of different methods (with renderings). Blank represents not able to generate any sequence or the sequence is not able to render shapes after removing irrelevant characters. (13 of 24)

[SOL] Line 223 128 Line 223 188 Line 202 188 Line 202 156 Line 147 156 Line 147 188 Line 128 188 Line 128 128 Extrude 192 64 192 124 127 121 86 222 129 New_body Two_sided [SEP] [SOL] Circle 176 128 48 Extrude 128 128 128 196 76 183 12 127 128 Cut Symmetric [SEP] [EOS]		Input
		Target Shape
```\n[SOL] Line 223 128 Line 223 188 Line 202 188 Line 202 156 Line 147 156 Line 147 188 Line 128 188 Line 128 128 Extrude 192 64 192 124 127 121 86 222 129 New_body Two_sided [SEP] \n[SOL] Line 147 188 Line 188 188 Line 188 156 Line 147 156 Extrude 128 128 128 196 76 183 12 127 128 Cut Symmetric [SEP] \n[EOS]\n```\n		GPT-4o
[SOL] Line 223 128 Line 223 188 Line 202 188 Line 202 156 Line 147 156 Line 147 188 Line 128 188 Line 128 128 Extrude 192 64 192 124 127 121 86 222 129 New_body Two_sided [SEP] [SOL] Line 147 156 Line 147 188 Line 202 188 Line 202 156 Extrude 128 128 128 196 76 183 12 127 128 Cut Symmetric [SEP] [EOS]		o4-mini
[SOL]\nLine 223 128\nLine 223 188\nLine 202 188\nLine 202 156\nLine 147 156\nLine 147 188\nLine 128 188\nLine 128 128 Extrude 192 64 192 124 127 121 86 222 129 New_body Two_sided\n[SEP]\n[SOL]\nLine 153 128\nLine 153 156\nLine 207 156\nLine 207 128\nLine 153 128\nExtrude 128 128 128 196 76 183 12 127 128 Cut Symmetric\n[SEP]\n[EOS]		o4-mini-high
[SOL] Line 223 128 Line 223 165 Line 176 165 Line 176 194 Line 128 194 Line 128 128 Extrude 192 64 192 48 127 59 156 224 128 New_body One_sided [SEP] [SOL] Line 223 128 Line 223 160 Line 128 160 Line 128 128 Extrude 128 128 128 73 71 127 97 176 128 Cut One_sided [SEP] [EOS]		CAD-Diffuser
[SOL] Line 223 128 Line 223 188 Line 204 188 Line 204 156 Line 147 156 Line 147 188 Line 128 188 Line 128 128 Extrude 192 64 192 46 126 70 178 180 128 New_body One_sided [SEP] [SOL] Circle 176 128 48 Extrude 192 64 192 115 71 123 5 92 128 Cut One_sided [SEP] [EOS]		FlexCAD
[SOL] Line 223 128 Line 223 188 Line 202 188 Line 202 156 Line 147 156 Line 147 188 Line 128 188 Line 128 128 Extrude 192 64 192 124 127 121 86 222 129 New_body Two_sided [SEP] [SOL] Line 223 128 Line 223 223 Line 128 223 Line 128 128 Extrude 128 128 128 197 74 183 18 127 128 Cut Symmetric [SEP] [EOS]		Ours

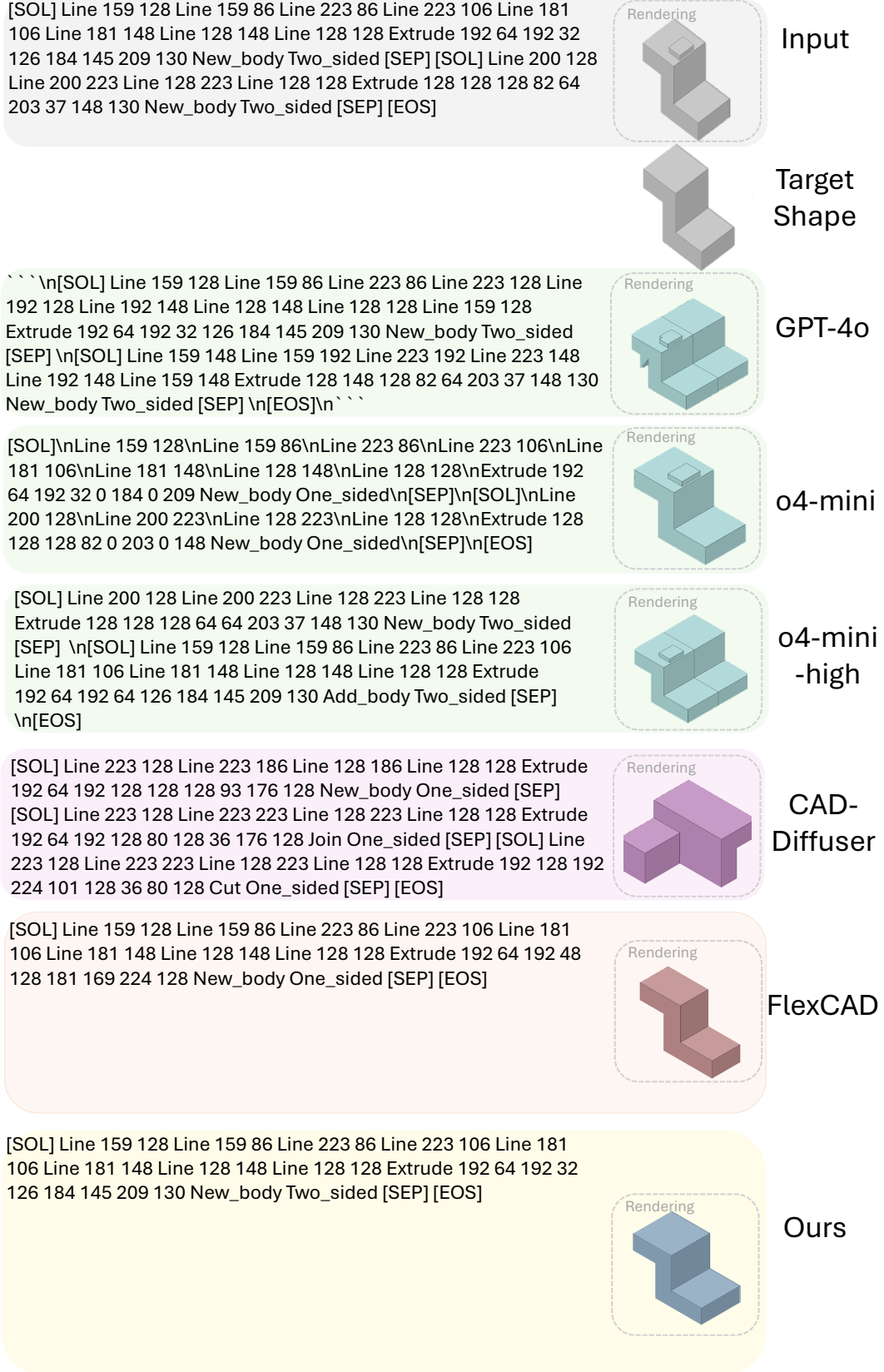
(14)

Figure 18: Full results of the original parametric sequence (with renderings), target shapes, and the edited sequence of different methods (with renderings). Blank represents not able to generate any sequence or the sequence is not able to render shapes after removing irrelevant characters. (14 of 24)



(15)

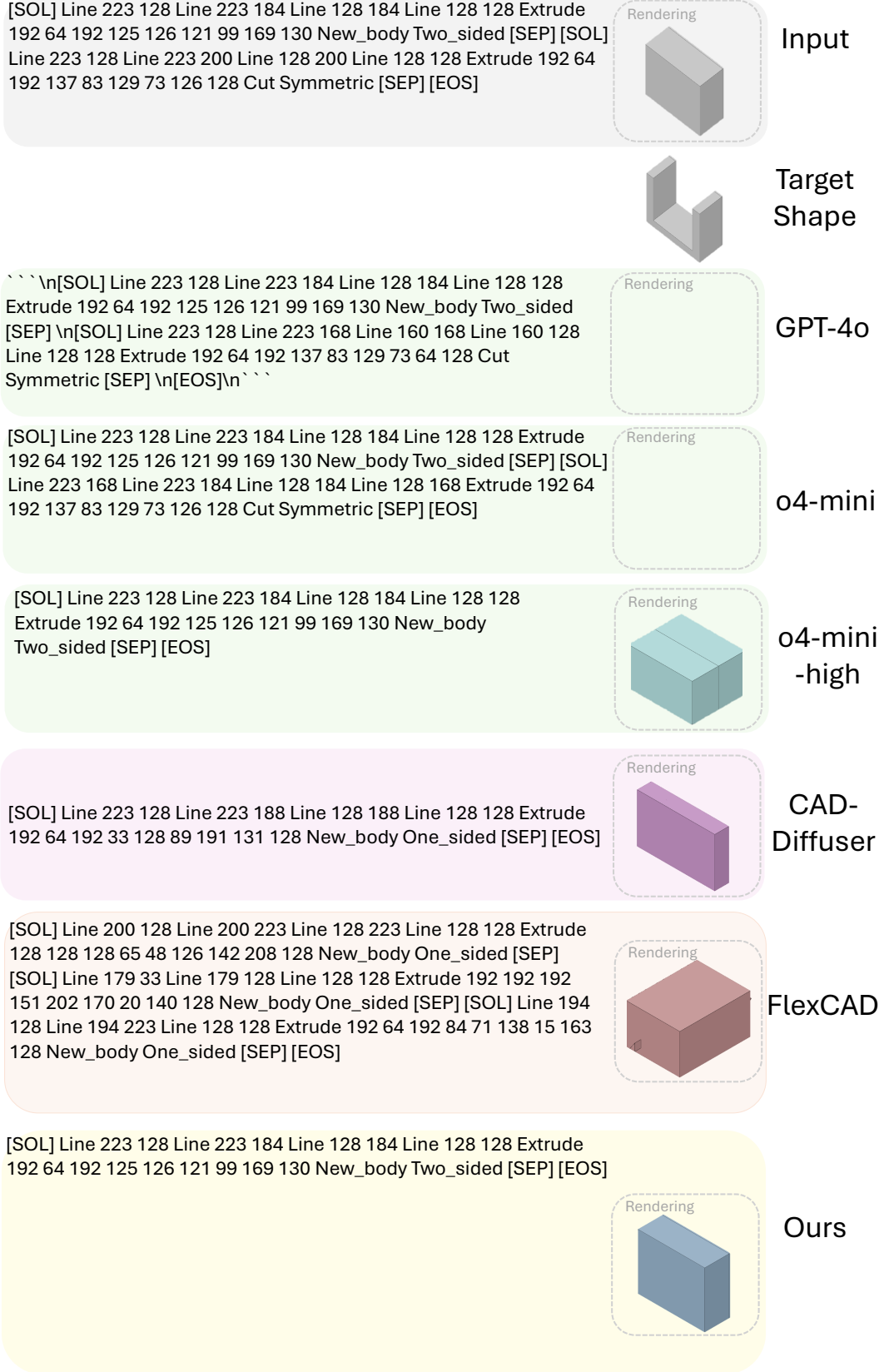
Figure 19: Full results of the original parametric sequence (with renderings), target shapes, and the edited sequence of different methods (with renderings). Blank represents not able to generate any sequence or the sequence is not able to render shapes after removing irrelevant characters. (15 of 24)



(16)

Figure 20: Full results of the original parametric sequence (with renderings), target shapes, and the edited sequence of different methods (with renderings). Blank represents not able to generate any sequence or the sequence is not able to render shapes after removing irrelevant characters. (16 of 24)

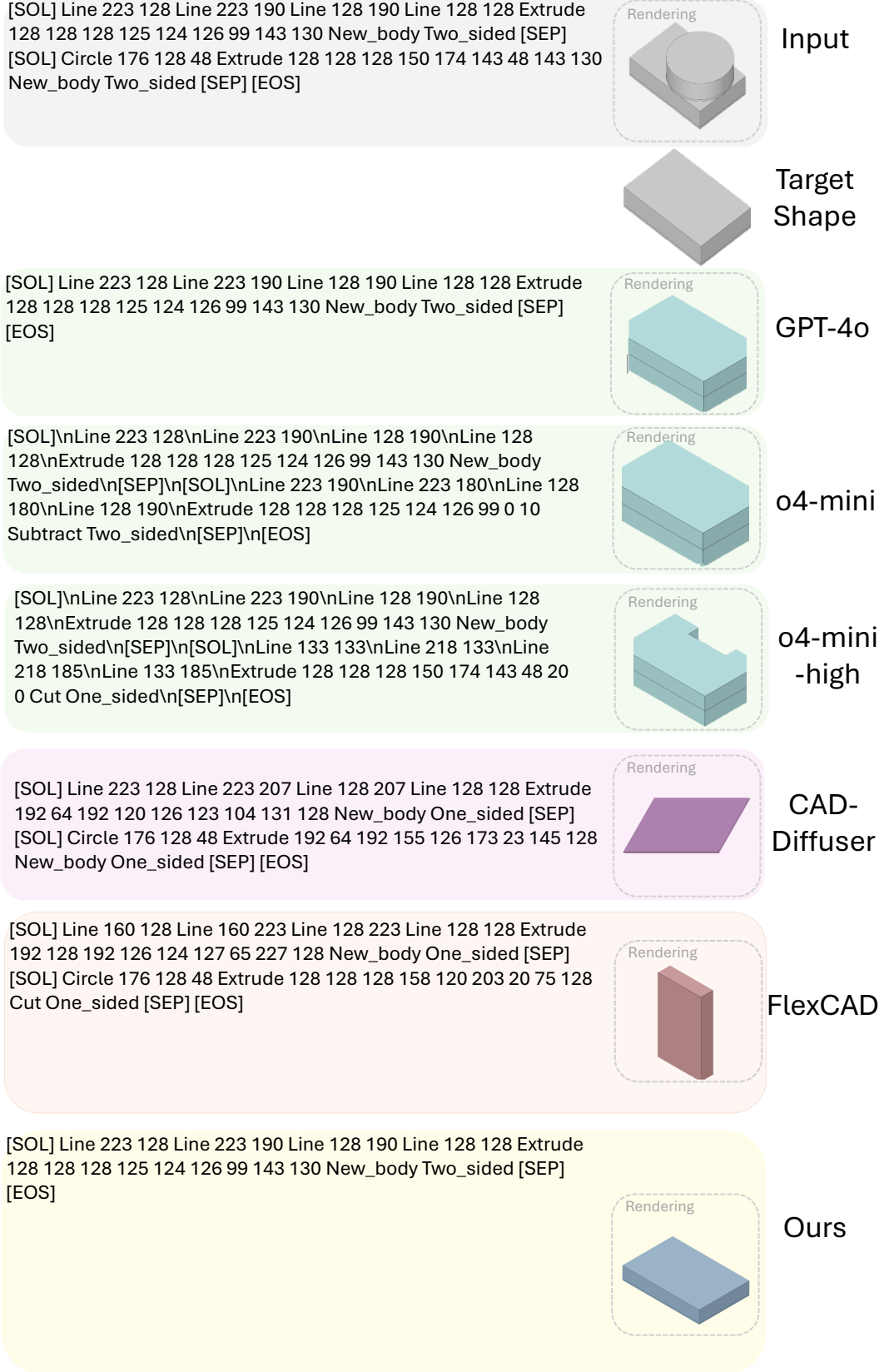




(17)

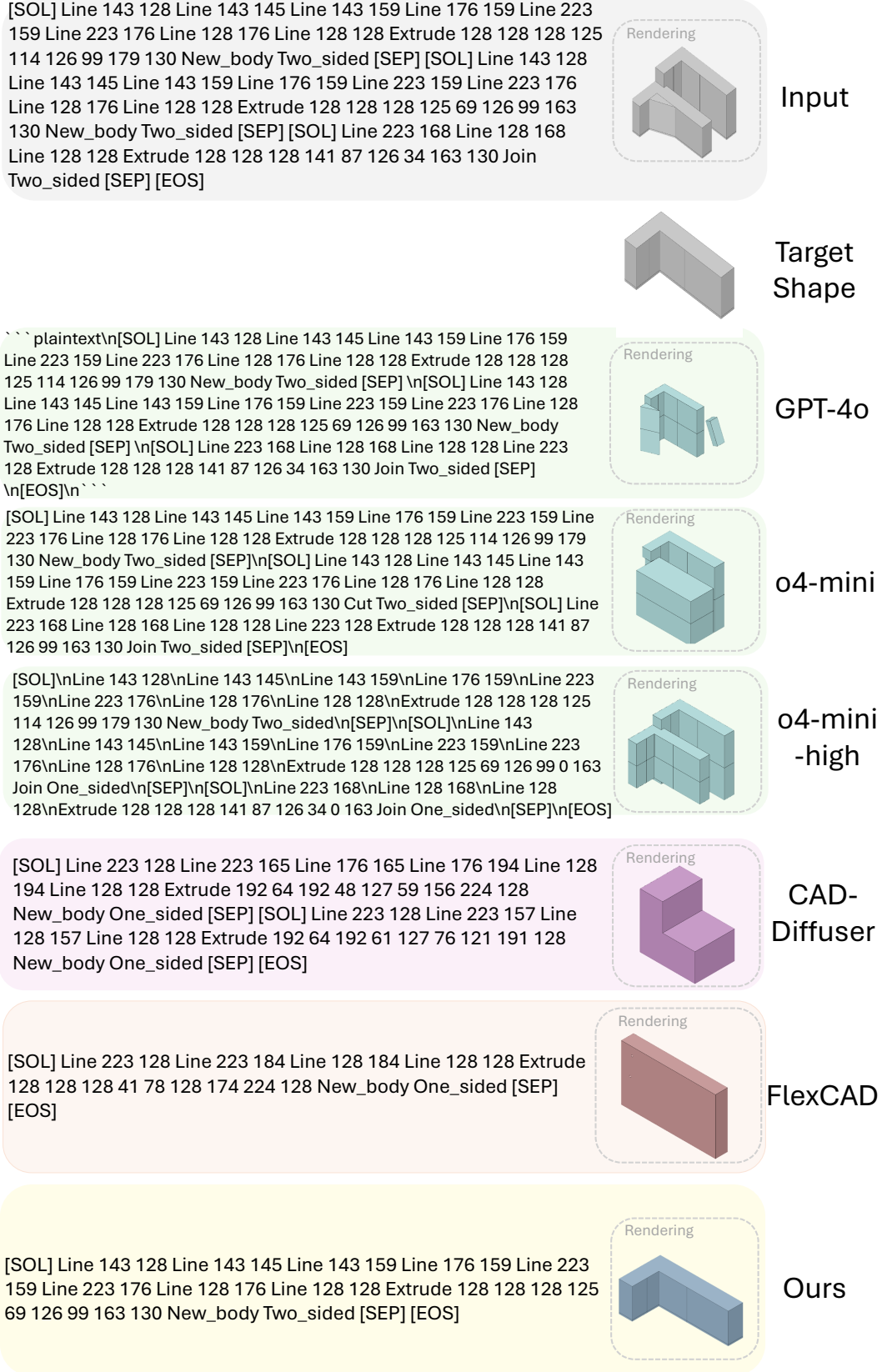
Figure 21: Full results of the original parametric sequence (with renderings), target shapes, and the edited sequence of different methods (with renderings). Blank represents not able to generate any sequence or the sequence is not able to render shapes after removing irrelevant characters. (17 of 24)





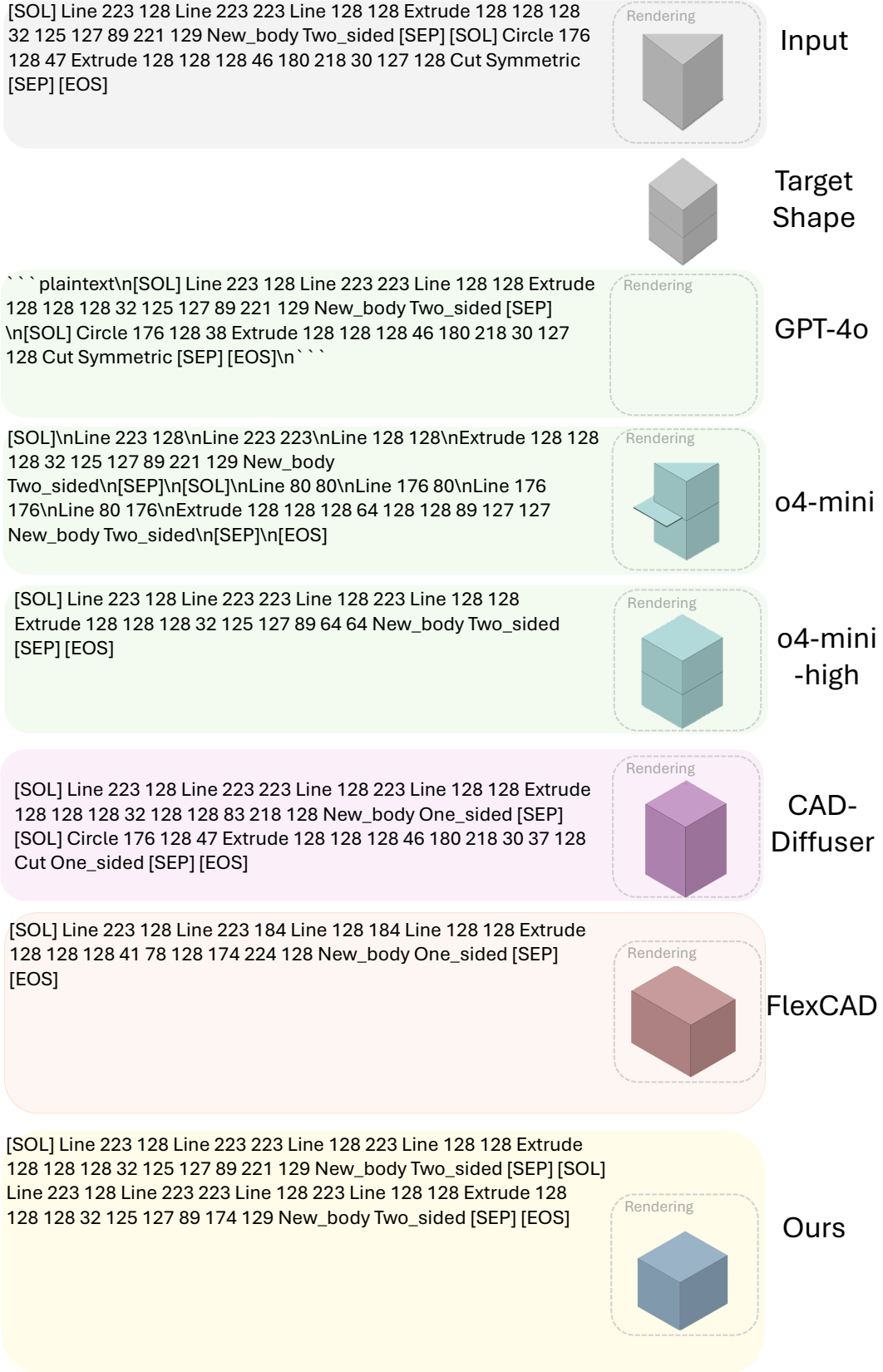
(18)

Figure 22: Full results of the original parametric sequence (with renderings), target shapes, and the edited sequence of different methods (with renderings). Blank represents not able to generate any sequence or the sequence is not able to render shapes after removing irrelevant characters. (18 of 24)



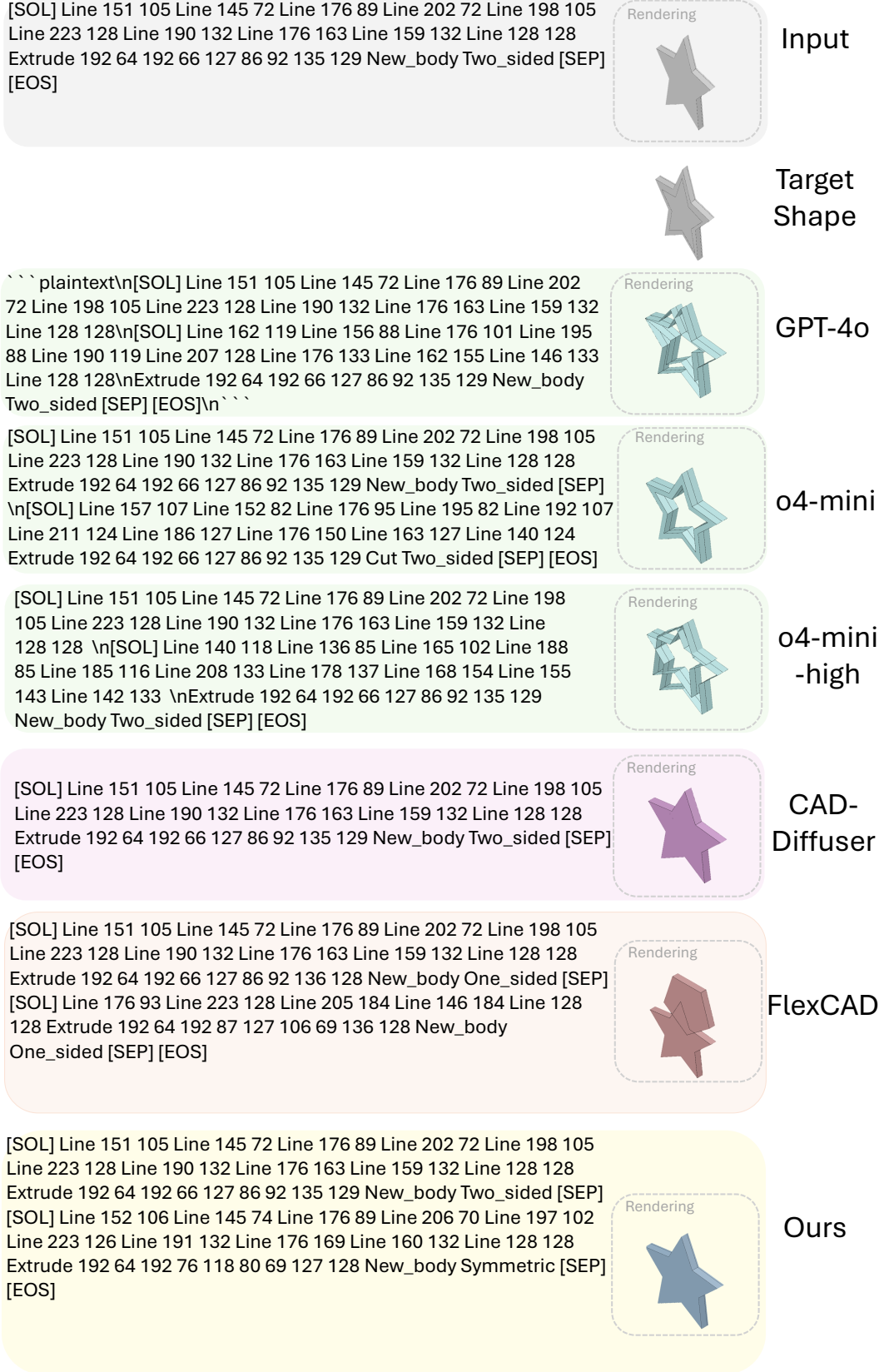
(19)

Figure 23: Full results of the original parametric sequence (with renderings), target shapes, and the edited sequence of different methods (with renderings). Blank represents not able to generate any sequence or the sequence is not able to render shapes after removing irrelevant characters. (19 of 24)



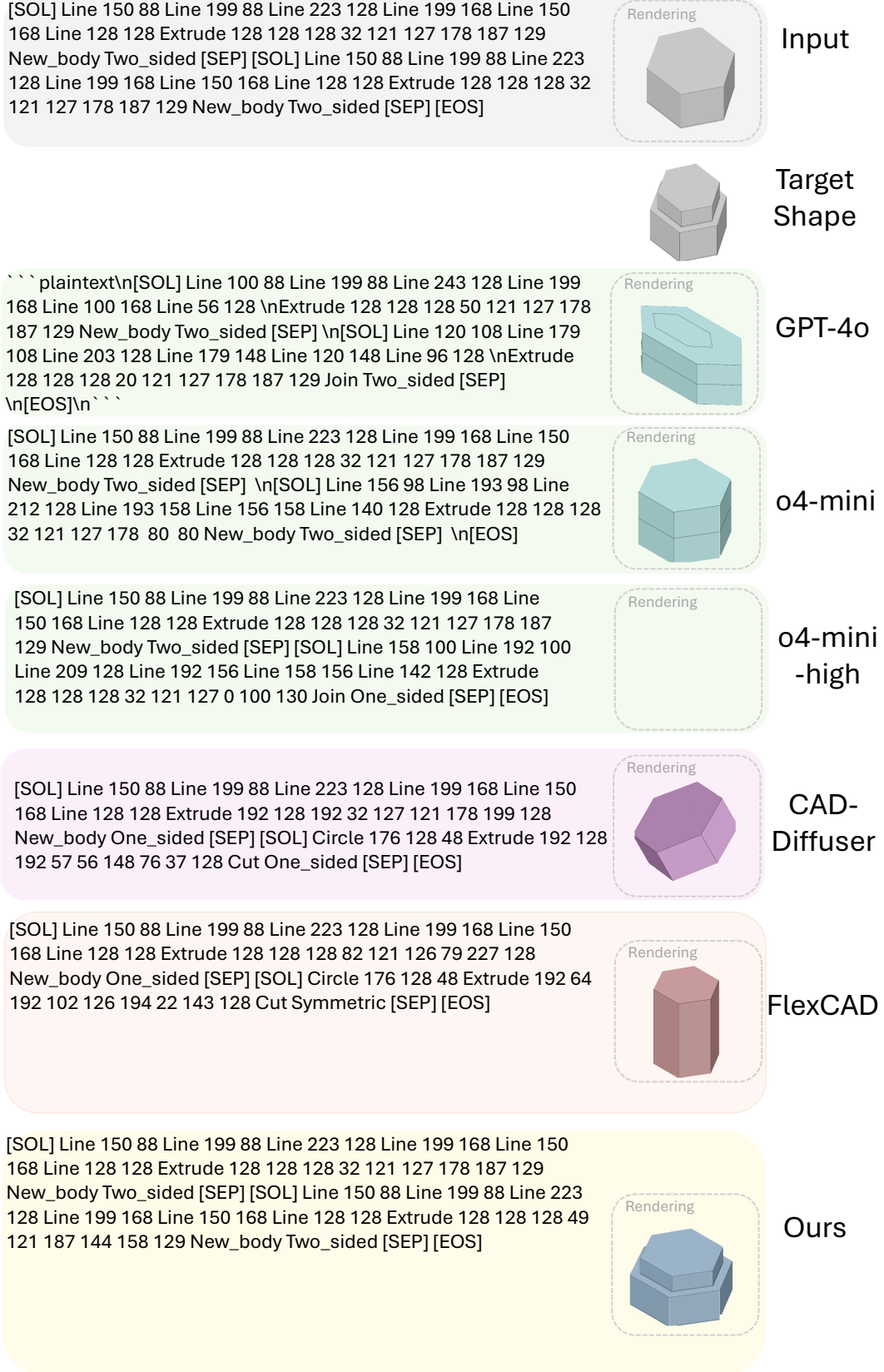
(20)

Figure 24: Full results of the original parametric sequence (with renderings), target shapes, and the edited sequence of different methods (with renderings). Blank represents not able to generate any sequence or the sequence is not able to render shapes after removing irrelevant characters. (20 of 24)



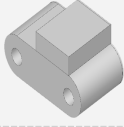
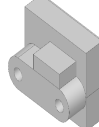
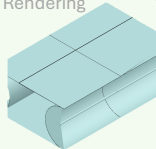
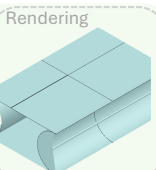
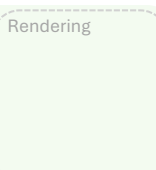
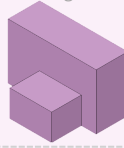
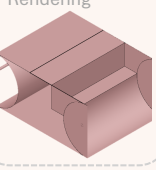
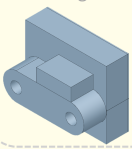
(21)

Figure 25: Full results of the original parametric sequence (with renderings), target shapes, and the edited sequence of different methods (with renderings). Blank represents not able to generate any sequence or the sequence is not able to render shapes after removing irrelevant characters. (21 of 24)



(22)

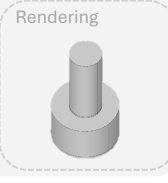
Figure 26: Full results of the original parametric sequence (with renderings), target shapes, and the edited sequence of different methods (with renderings). Blank represents not able to generate any sequence or the sequence is not able to render shapes after removing irrelevant characters. (22 of 24)

[SOL] Circle 134 128 6 [SOL] Arc 138 146 124 Counterclockwise Line 169 146 Line 222 146 Arc 222 104 132 Counterclockwise Line 138 104 [SOL] Circle 217 128 6 Extrude 192 64 192 115 126 123 91 192 130 New_body Two_sided [SEP] [SOL] Line 223 128 Line 223 164 Line 128 164 Line 128 128 Extrude 192 64 192 154 126 140 51 192 130 Join Two_sided [SEP] [EOS]	Rendering 	Input
		Target Shape
```\n[SOL] Line 207 128 Line 207 136 Line 191 136 Line 191 223 Line 144 223 Line 144 136 Line 128 136 Line 128 128 Extrude 128 128 128 47 32 127 178 155 129 New_body Two_sided [SEP]\n[SOL] Circle 168 168 24 Extrude 168 168 128 24 0 24 200 200 129 Cut Two_sided [SEP] [EOS]\n```\n	Rendering 	GPT-4o
[SOL] Circle 134 128 6 [SOL] Arc 138 146 124 Counterclockwise Line 169 146 Line 222 146 Arc 222 104 132 Counterclockwise Line 138 104 [SOL] Circle 217 128 6 Extrude 192 64 192 115 126 123 91 192 130 Cut Two_sided [SEP] [SOL] Line 223 128 Line 223 164 Line 128 164 Line 128 128 Extrude 192 64 192 154 126 140 51 192 130 Join One_sided [SEP] [EOS]	Rendering 	o4-mini
[SOL] Circle 167 128 39 [SOL] Circle 163 104 5 [SOL] Circle 187 108 11 [SOL] Circle 190 77 5 [SOL] Circle 190 132 5 [SOL] Circle 218 104 5 Extrude 192 64 192 32 127 121 64 131 128 New_body Symmetric [SEP] [SOL] Circle 176 128 47 [SOL] Circle 183 120 37 Extrude 192 64 192 39 127 104 31 131 128 New_body Symmetric [SEP] [EOS]	Rendering 	o4-mini-high
[SOL] Line 171 128 Line 171 223 Line 128 223 Line 128 128 Extrude 192 64 192 86 126 43 156 224 128 New_body Symmetric [SEP] [SOL] Line 223 128 Line 223 223 Line 128 223 Line 128 128 Extrude 192 64 192 88 126 88 66 32 147 Cut Two_sided [SEP] [EOS]	Rendering 	CAD-Diffuser
[SOL ] Circle 134 128 6 [SOL] Arc 138 146 124 Counterclockwise Line 169 146 Line 222 146 Arc 222 104 132 Counterclockwise Line 138 104 [SOL] Circle 217 128 6 Extrude 192 64 192 115 126 123 91 193 128 New_body One_sided [SEP] [SOL] Line 223 128 Line 223 164 Line 128 164 Line 128 128 Extrude 192 64 192 154 126 140 51 193 128 Join One_sided [SEP] [SOL] Line 223 128 Line 223 211 Line 128 211 Line 128 128 Extrude 192 64 192 173 126 122 51 193 128 New_body One_sided [SEP] [EOS]	Rendering 	FlexCAD
[SOL] Circle 134 128 6 [SOL] Arc 138 146 124 Counterclockwise Line 169 146 Line 222 146 Arc 222 104 132 Counterclockwise Line 138 104 [SOL] Circle 217 128 6 Extrude 192 64 192 115 126 123 91 193 128 New_body One_sided [SEP] [SOL] Line 223 128 Line 223 164 Line 128 164 Line 128 128 Extrude 192 64 192 154 126 140 50 193 128 Join One_sided [SEP] [SOL] Line 223 128 Line 223 162 Line 128 162 Line 128 128 Extrude 192 64 192 106 126 80 118 161 128 New_body One_sided [SEP] [SOL] Line 223 128 Line 223 174 Line 128 174 Line 128 128 Extrude 192 64 192 106 126 122 118 161 128 Join One_sided [SEP] [EOS]	Rendering 	Ours

(23)

Figure 27: Full results of the original parametric sequence (with renderings), target shapes, and the edited sequence of different methods (with renderings). Blank represents not able to generate any sequence or the sequence is not able to render shapes after removing irrelevant characters. (23 of 24)

[SOL] Circle 176 128 48 Extrude 128 128 128 32 153 126 100 177 130  
New\_body Two\_sided [SEP] [EOS]

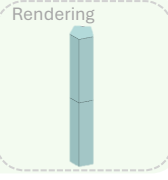


Input



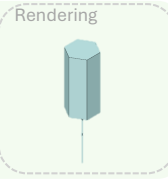
Target  
Shape

```\n[SOL] Circle 176 128 48 Extrude 128 128 128 32 153 126 100  
177 130 New\_body Two\_sided [SEP] \n[SOL] Line 100 100 150 50  
Line 150 50 200 100 Line 200 100 175 175 Line 175 175 125 175 Line  
125 175 100 100 Extrude 128 128 128 0 0 0 100 100 Cut Two\_sided  
[SEP] [EOS]\n```\n



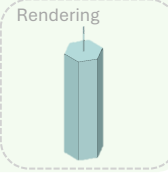
GPT-4o

[SOL] Circle 176 128 48 Extrude 128 128 128 65 145 126 66 161 130  
New\_body Two\_sided [SEP] \n[SOL] Line 223 128 Line 200 169 Line  
153 169 Line 129 128 Line 153 87 Line 200 87 Extrude 128 128 128  
94 133 161 32 32 80 New\_body Two\_sided [SEP] \n[EOS]



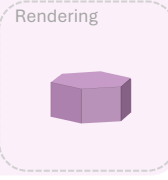
o4-mini

[SOL] Circle 176 128 48 \nExtrude 128 128 128 32 153 126 100  
177 130 New\_body Two\_sided \n[SEP] \n[SOL] Line 204 128  
Line 190 152 Line 162 152 Line 148 128 Line 162 104 Line 190  
104 \nExtrude 128 128 128 32 153 126 100 177 130 Cut  
Two\_sided \n[SEP] \n[EOS]



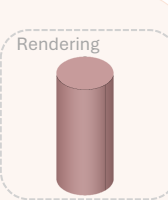
o4-mini  
-high

[SOL] Line 150 88 Line 199 88 Line 223 128 Line 199 168 Line 150  
168 Line 128 128 Extrude 128 128 128 82 121 126 79 162 128  
New\_body One\_sided [SEP] [SOL] Circle 176 128 47 Extrude 128 128  
128 89 135 126 39 162 128 Cut One\_sided [SEP] [EOS]



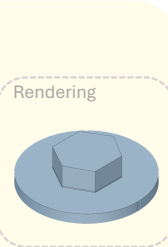
CAD-  
Diffuser

[SOL] Circle 176 128 48 Extrude 192 64 192 109 128 128 38 224 128  
New\_body Symmetric [SEP] [EOS]



FlexCAD

[SOL] Circle 176 128 48 Extrude 128 128 128 32 153 126 100 177 130  
New\_body Two\_sided [SEP] [SOL] Line 176 102 Line 223 128 Line  
223 187 Line 176 216 Line 128 187 Line 128 128 Extrude 128 128 128  
79 93 177 79 126 128 Cut Symmetric [SEP] [EOS]



Ours

(24)

Figure 28: Full results of the original parametric sequence (with renderings), target shapes, and the edited sequence of different methods (with renderings). Blank represents not able to generate any sequence or the sequence is not able to render shapes after removing irrelevant characters. (24 of 24)

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