

Introduction

Students at Hutchinson Central Technical High School that are enrolled in the Engineering Technology major use a variety of different engineering based software to engage in a problem solving, project based curriculum. One of the software the students use in their Engineering CAD class is Autodesk Inventor. Inventor is a 3D modeling computer aided design software used to create three dimensional objects, assemblies and two dimensional technical drawings and other technical document. The software is also equipped with Finite Element Analysis (FEA) simulation modules that have the ability to test specific design and engineering attributes of the 3D models in a virtual environment. This researcher, while highly skilled with modeling aspects of the software wished to increase understanding of the analysis abilities of Autodesk Inventor. The purpose of this research project was to gain a better understanding of FEA, learn to use the simulators properly and test the application potential of FEA in the High School classroom environment.

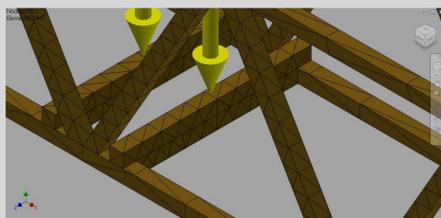
Finite Element Analysis

Finite Element Analysis (FEA)

Finite Element Analysis, or FEA, as described by Autodesk the software manufacture of Inventor is a computerized method for predicting how a product reacts to real-world forces, vibration, heat, fluid flow, and other physical effects. Finite element analysis shows whether a product will break, wear out, or work the way it was designed. It is called analysis, but in the product development process, it is used to predict what is going to happen when the product is used.

FEA works by breaking down a real object into a large number (thousands to hundreds of thousands) of finite elements, such as little cubes. Mathematical equations help predict the behavior of each element. A computer then adds up all the individual behaviors to predict the behavior of the actual object.

Finite element analysis helps predict the behavior of products affected by many physical effects



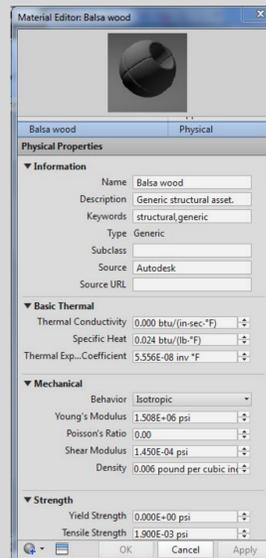
Application Project Selection

Each school year the Engineering Technology students at Hutchinson Central Technical H.S. compete in the Annual Tech Wars competition at Erie Community College. The competition consists of various events where students from area districts compete against each other to see who has the best design. Our students participate each year in the Balsa wood bridge event. The idea is to have the best strength to weight ratio. In the past we have always designed our bridges in 2D CAD. With the ability to use the 3D modeling software Inventor the opportunity to analyze the structures using FEA is presented. This is a project is an excellent candidate but we had to explore proper application requirements to ensure that virtual results would mimic real world testing.

Simulation Model Requirements

In order to research the analysis itself it was required for us to ensure every element for the simulation was satisfied. That included creating and assigning material properties for the Balsa wood and then building and constraining the model in the simulator.

The analysis itself is run through a simulation module. The simulation needed various inputs. The material properties of Balsa wood, as we discovered, varied greatly based on density.



Material(s)	
Name	Balsa wood
Mass Density	0.0088975 lbmass/in ³
Yield Strength	0 psi
Ultimate Tensile Strength	0.0019031 psi
Young's Modulus	1599.43 ksi
Poisson's Ratio	0.4
Shear Modulus	758.717 ksi
Thermal Expansion Coefficient	0.0000018 1/°F
Specific Heat	0.0017018 Btu/(lb·°F)
Thermal Conductivity	0.00088975 lbmass/in ³
Part Name(s)	FEA-B-CROSS-1 FEA-B-CROSS-2 FEA-B-CROSS-3 FEA-B-CROSS-4 FEA-B-CROSS-5 FEA-B-CROSS-6 FEA-B-CROSS-7 FEA-B-CROSS-8 FEA-B-CROSS-9 FEA-B-CROSS-10 FEA-B-CROSS-11 FEA-B-CROSS-12 FEA-B-CROSS-13 FEA-B-CROSS-14 FEA-B-CROSS-15 FEA-B-CROSS-16 FEA-B-CROSS-17 FEA-B-CROSS-18 FEA-B-CROSS-19 FEA-B-CROSS-20 FEA-B-CROSS-21 FEA-B-CROSS-22 FEA-B-CROSS-23 FEA-B-CROSS-24 FEA-B-CROSS-25 FEA-B-CROSS-26 FEA-B-CROSS-27 FEA-B-CROSS-28 FEA-B-CROSS-29 FEA-B-CROSS-30 FEA-B-CROSS-31 FEA-B-CROSS-32 FEA-B-CROSS-33 FEA-B-CROSS-34 FEA-B-CROSS-35 FEA-B-CROSS-36 FEA-B-CROSS-37 FEA-B-CROSS-38 FEA-B-CROSS-39 FEA-B-CROSS-40 FEA-B-CROSS-41 FEA-B-CROSS-42 FEA-B-CROSS-43 FEA-B-CROSS-44 FEA-B-CROSS-45 FEA-B-CROSS-46 FEA-B-CROSS-47 FEA-B-CROSS-48 FEA-B-CROSS-49 FEA-B-CROSS-50 FEA-B-CROSS-51 FEA-B-CROSS-52 FEA-B-CROSS-53 FEA-B-CROSS-54 FEA-B-CROSS-55 FEA-B-CROSS-56 FEA-B-CROSS-57 FEA-B-CROSS-58 FEA-B-CROSS-59 FEA-B-CROSS-60 FEA-B-CROSS-61 FEA-B-CROSS-62 FEA-B-CROSS-63 FEA-B-CROSS-64 FEA-B-CROSS-65 FEA-B-CROSS-66 FEA-B-CROSS-67 FEA-B-CROSS-68 FEA-B-CROSS-69 FEA-B-CROSS-70 FEA-B-CROSS-71 FEA-B-CROSS-72 FEA-B-CROSS-73 FEA-B-CROSS-74 FEA-B-CROSS-75 FEA-B-CROSS-76 FEA-B-CROSS-77 FEA-B-CROSS-78 FEA-B-CROSS-79 FEA-B-CROSS-80 FEA-B-CROSS-81 FEA-B-CROSS-82 FEA-B-CROSS-83 FEA-B-CROSS-84 FEA-B-CROSS-85 FEA-B-CROSS-86 FEA-B-CROSS-87 FEA-B-CROSS-88 FEA-B-CROSS-89 FEA-B-CROSS-90 FEA-B-CROSS-91 FEA-B-CROSS-92 FEA-B-CROSS-93 FEA-B-CROSS-94 FEA-B-CROSS-95 FEA-B-CROSS-96 FEA-B-CROSS-97 FEA-B-CROSS-98 FEA-B-CROSS-99 FEA-B-CROSS-100 FEA-B-CROSS-101 FEA-B-CROSS-102 FEA-B-CROSS-103 FEA-B-CROSS-104 FEA-B-CROSS-105 FEA-B-CROSS-106 FEA-B-CROSS-107 FEA-B-CROSS-108 FEA-B-CROSS-109 FEA-B-CROSS-110 FEA-B-CROSS-111 FEA-B-CROSS-112 FEA-B-CROSS-113 FEA-B-CROSS-114 FEA-B-CROSS-115 FEA-B-CROSS-116 FEA-B-CROSS-117 FEA-B-CROSS-118 FEA-B-CROSS-119 FEA-B-CROSS-120 FEA-B-CROSS-121 FEA-B-CROSS-122 FEA-B-CROSS-123 FEA-B-CROSS-124 FEA-B-CROSS-125 FEA-B-CROSS-126 FEA-B-CROSS-127 FEA-B-CROSS-128 FEA-B-CROSS-129 FEA-B-CROSS-130 FEA-B-CROSS-131 FEA-B-CROSS-132 FEA-B-CROSS-133 FEA-B-CROSS-134 FEA-B-CROSS-135 FEA-B-CROSS-136 FEA-B-CROSS-137 FEA-B-CROSS-138 FEA-B-CROSS-139 FEA-B-CROSS-140 FEA-B-CROSS-141 FEA-B-CROSS-142 FEA-B-CROSS-143 FEA-B-CROSS-144 FEA-B-CROSS-145 FEA-B-CROSS-146 FEA-B-CROSS-147 FEA-B-CROSS-148 FEA-B-CROSS-149 FEA-B-CROSS-150 FEA-B-CROSS-151 FEA-B-CROSS-152 FEA-B-CROSS-153 FEA-B-CROSS-154 FEA-B-CROSS-155 FEA-B-CROSS-156 FEA-B-CROSS-157 FEA-B-CROSS-158 FEA-B-CROSS-159 FEA-B-CROSS-160 FEA-B-CROSS-161 FEA-B-CROSS-162 FEA-B-CROSS-163 FEA-B-CROSS-164 FEA-B-CROSS-165 FEA-B-CROSS-166 FEA-B-CROSS-167 FEA-B-CROSS-168 FEA-B-CROSS-169 FEA-B-CROSS-170 FEA-B-CROSS-171 FEA-B-CROSS-172 FEA-B-CROSS-173 FEA-B-CROSS-174 FEA-B-CROSS-175 FEA-B-CROSS-176 FEA-B-CROSS-177 FEA-B-CROSS-178 FEA-B-CROSS-179 FEA-B-CROSS-180 FEA-B-CROSS-181 FEA-B-CROSS-182 FEA-B-CROSS-183 FEA-B-CROSS-184 FEA-B-CROSS-185 FEA-B-CROSS-186 FEA-B-CROSS-187 FEA-B-CROSS-188 FEA-B-CROSS-189 FEA-B-CROSS-190 FEA-B-CROSS-191 FEA-B-CROSS-192 FEA-B-CROSS-193 FEA-B-CROSS-194 FEA-B-CROSS-195 FEA-B-CROSS-196 FEA-B-CROSS-197 FEA-B-CROSS-198 FEA-B-CROSS-199 FEA-B-CROSS-200 FEA-B-CROSS-201 FEA-B-CROSS-202 FEA-B-CROSS-203 FEA-B-CROSS-204 FEA-B-CROSS-205 FEA-B-CROSS-206 FEA-B-CROSS-207 FEA-B-CROSS-208 FEA-B-CROSS-209 FEA-B-CROSS-210 FEA-B-CROSS-211 FEA-B-CROSS-212 FEA-B-CROSS-213 FEA-B-CROSS-214 FEA-B-CROSS-215 FEA-B-CROSS-216 FEA-B-CROSS-217 FEA-B-CROSS-218 FEA-B-CROSS-219 FEA-B-CROSS-220 FEA-B-CROSS-221 FEA-B-CROSS-222 FEA-B-CROSS-223 FEA-B-CROSS-224 FEA-B-CROSS-225 FEA-B-CROSS-226 FEA-B-CROSS-227 FEA-B-CROSS-228 FEA-B-CROSS-229 FEA-B-CROSS-230 FEA-B-CROSS-231 FEA-B-CROSS-232 FEA-B-CROSS-233 FEA-B-CROSS-234 FEA-B-CROSS-235 FEA-B-CROSS-236 FEA-B-CROSS-237 FEA-B-CROSS-238 FEA-B-CROSS-239 FEA-B-CROSS-240 FEA-B-CROSS-241 FEA-B-CROSS-242 FEA-B-CROSS-243 FEA-B-CROSS-244 FEA-B-CROSS-245 FEA-B-CROSS-246 FEA-B-CROSS-247 FEA-B-CROSS-248 FEA-B-CROSS-249 FEA-B-CROSS-250 FEA-B-CROSS-251 FEA-B-CROSS-252 FEA-B-CROSS-253 FEA-B-CROSS-254 FEA-B-CROSS-255 FEA-B-CROSS-256 FEA-B-CROSS-257 FEA-B-CROSS-258 FEA-B-CROSS-259 FEA-B-CROSS-260 FEA-B-CROSS-261 FEA-B-CROSS-262 FEA-B-CROSS-263 FEA-B-CROSS-264 FEA-B-CROSS-265 FEA-B-CROSS-266 FEA-B-CROSS-267 FEA-B-CROSS-268 FEA-B-CROSS-269 FEA-B-CROSS-270 FEA-B-CROSS-271 FEA-B-CROSS-272 FEA-B-CROSS-273 FEA-B-CROSS-274 FEA-B-CROSS-275 FEA-B-CROSS-276 FEA-B-CROSS-277 FEA-B-CROSS-278 FEA-B-CROSS-279 FEA-B-CROSS-280 FEA-B-CROSS-281 FEA-B-CROSS-282 FEA-B-CROSS-283 FEA-B-CROSS-284 FEA-B-CROSS-285 FEA-B-CROSS-286 FEA-B-CROSS-287 FEA-B-CROSS-288 FEA-B-CROSS-289 FEA-B-CROSS-290 FEA-B-CROSS-291 FEA-B-CROSS-292 FEA-B-CROSS-293 FEA-B-CROSS-294 FEA-B-CROSS-295 FEA-B-CROSS-296 FEA-B-CROSS-297 FEA-B-CROSS-298 FEA-B-CROSS-299 FEA-B-CROSS-300 FEA-B-CROSS-301 FEA-B-CROSS-302 FEA-B-CROSS-303 FEA-B-CROSS-304 FEA-B-CROSS-305 FEA-B-CROSS-306 FEA-B-CROSS-307 FEA-B-CROSS-308 FEA-B-CROSS-309 FEA-B-CROSS-310 FEA-B-CROSS-311 FEA-B-CROSS-312 FEA-B-CROSS-313 FEA-B-CROSS-314 FEA-B-CROSS-315 FEA-B-CROSS-316 FEA-B-CROSS-317 FEA-B-CROSS-318 FEA-B-CROSS-319 FEA-B-CROSS-320 FEA-B-CROSS-321 FEA-B-CROSS-322 FEA-B-CROSS-323 FEA-B-CROSS-324 FEA-B-CROSS-325 FEA-B-CROSS-326 FEA-B-CROSS-327 FEA-B-CROSS-328 FEA-B-CROSS-329 FEA-B-CROSS-330 FEA-B-CROSS-331 FEA-B-CROSS-332 FEA-B-CROSS-333 FEA-B-CROSS-334 FEA-B-CROSS-335 FEA-B-CROSS-336 FEA-B-CROSS-337 FEA-B-CROSS-338 FEA-B-CROSS-339 FEA-B-CROSS-340 FEA-B-CROSS-341 FEA-B-CROSS-342 FEA-B-CROSS-343 FEA-B-CROSS-344 FEA-B-CROSS-345 FEA-B-CROSS-346 FEA-B-CROSS-347 FEA-B-CROSS-348 FEA-B-CROSS-349 FEA-B-CROSS-350 FEA-B-CROSS-351 FEA-B-CROSS-352 FEA-B-CROSS-353 FEA-B-CROSS-354 FEA-B-CROSS-355 FEA-B-CROSS-356 FEA-B-CROSS-357 FEA-B-CROSS-358 FEA-B-CROSS-359 FEA-B-CROSS-360 FEA-B-CROSS-361 FEA-B-CROSS-362 FEA-B-CROSS-363 FEA-B-CROSS-364 FEA-B-CROSS-365 FEA-B-CROSS-366 FEA-B-CROSS-367 FEA-B-CROSS-368 FEA-B-CROSS-369 FEA-B-CROSS-370 FEA-B-CROSS-371 FEA-B-CROSS-372 FEA-B-CROSS-373 FEA-B-CROSS-374 FEA-B-CROSS-375 FEA-B-CROSS-376 FEA-B-CROSS-377 FEA-B-CROSS-378 FEA-B-CROSS-379 FEA-B-CROSS-380 FEA-B-CROSS-381 FEA-B-CROSS-382 FEA-B-CROSS-383 FEA-B-CROSS-384 FEA-B-CROSS-385 FEA-B-CROSS-386 FEA-B-CROSS-387 FEA-B-CROSS-388 FEA-B-CROSS-389 FEA-B-CROSS-390 FEA-B-CROSS-391 FEA-B-CROSS-392 FEA-B-CROSS-393 FEA-B-CROSS-394 FEA-B-CROSS-395 FEA-B-CROSS-396 FEA-B-CROSS-397 FEA-B-CROSS-398 FEA-B-CROSS-399 FEA-B-CROSS-400 FEA-B-CROSS-401 FEA-B-CROSS-402 FEA-B-CROSS-403 FEA-B-CROSS-404 FEA-B-CROSS-405 FEA-B-CROSS-406 FEA-B-CROSS-407 FEA-B-CROSS-408 FEA-B-CROSS-409 FEA-B-CROSS-410 FEA-B-CROSS-411 FEA-B-CROSS-412 FEA-B-CROSS-413 FEA-B-CROSS-414 FEA-B-CROSS-415 FEA-B-CROSS-416 FEA-B-CROSS-417 FEA-B-CROSS-418 FEA-B-CROSS-419 FEA-B-CROSS-420 FEA-B-CROSS-421 FEA-B-CROSS-422 FEA-B-CROSS-423 FEA-B-CROSS-424 FEA-B-CROSS-425 FEA-B-CROSS-426 FEA-B-CROSS-427 FEA-B-CROSS-428 FEA-B-CROSS-429 FEA-B-CROSS-430 FEA-B-CROSS-431 FEA-B-CROSS-432 FEA-B-CROSS-433 FEA-B-CROSS-434 FEA-B-CROSS-435 FEA-B-CROSS-436 FEA-B-CROSS-437 FEA-B-CROSS-438 FEA-B-CROSS-439 FEA-B-CROSS-440 FEA-B-CROSS-441 FEA-B-CROSS-442 FEA-B-CROSS-443 FEA-B-CROSS-444 FEA-B-CROSS-445 FEA-B-CROSS-446 FEA-B-CROSS-447 FEA-B-CROSS-448 FEA-B-CROSS-449 FEA-B-CROSS-450 FEA-B-CROSS-451 FEA-B-CROSS-452 FEA-B-CROSS-453 FEA-B-CROSS-454 FEA-B-CROSS-455 FEA-B-CROSS-456 FEA-B-CROSS-457 FEA-B-CROSS-458 FEA-B-CROSS-459 FEA-B-CROSS-460 FEA-B-CROSS-461 FEA-B-CROSS-462 FEA-B-CROSS-463 FEA-B-CROSS-464 FEA-B-CROSS-465 FEA-B-CROSS-466 FEA-B-CROSS-467 FEA-B-CROSS-468 FEA-B-CROSS-469 FEA-B-CROSS-470 FEA-B-CROSS-471 FEA-B-CROSS-472 FEA-B-CROSS-473 FEA-B-CROSS-474 FEA-B-CROSS-475 FEA-B-CROSS-476 FEA-B-CROSS-477 FEA-B-CROSS-478 FEA-B-CROSS-479 FEA-B-CROSS-480 FEA-B-CROSS-481 FEA-B-CROSS-482 FEA-B-CROSS-483 FEA-B-CROSS-484 FEA-B-CROSS-485 FEA-B-CROSS-486 FEA-B-CROSS-487 FEA-B-CROSS-488 FEA-B-CROSS-489 FEA-B-CROSS-490 FEA-B-CROSS-491 FEA-B-CROSS-492 FEA-B-CROSS-493 FEA-B-CROSS-494 FEA-B-CROSS-495 FEA-B-CROSS-496 FEA-B-CROSS-497 FEA-B-CROSS-498 FEA-B-CROSS-499 FEA-B-CROSS-500 FEA-B-CROSS-501 FEA-B-CROSS-502 FEA-B-CROSS-503 FEA-B-CROSS-504 FEA-B-CROSS-505 FEA-B-CROSS-506 FEA-B-CROSS-507 FEA-B-CROSS-508 FEA-B-CROSS-509 FEA-B-CROSS-510 FEA-B-CROSS-511 FEA-B-CROSS-512 FEA-B-CROSS-513 FEA-B-CROSS-514 FEA-B-CROSS-515 FEA-B-CROSS-516 FEA-B-CROSS-517 FEA-B-CROSS-518 FEA-B-CROSS-519 FEA-B-CROSS-520 FEA-B-CROSS-521 FEA-B-CROSS-522 FEA-B-CROSS-523 FEA-B-CROSS-524 FEA-B-CROSS-525 FEA-B-CROSS-526 FEA-B-CROSS-527 FEA-B-CROSS-528 FEA-B-CROSS-529 FEA-B-CROSS-530 FEA-B-CROSS-531 FEA-B-CROSS-532 FEA-B-CROSS-533 FEA-B-CROSS-534 FEA-B-CROSS-535 FEA-B-CROSS-536 FEA-B-CROSS-537 FEA-B-CROSS-538 FEA-B-CROSS-539 FEA-B-CROSS-540 FEA-B-CROSS-541 FEA-B-CROSS-542 FEA-B-CROSS-543 FEA-B-CROSS-544 FEA-B-CROSS-545 FEA-B-CROSS-546 FEA-B-CROSS-547 FEA-B-CROSS-548 FEA-B-CROSS-549 FEA-B-CROSS-550 FEA-B-CROSS-551 FEA-B-CROSS-552 FEA-B-CROSS-553 FEA-B-CROSS-554 FEA-B-CROSS-555 FEA-B-CROSS-556 FEA-B-CROSS-557 FEA-B-CROSS-558 FEA-B-CROSS-559 FEA-B-CROSS-560 FEA-B-CROSS-561 FEA-B-CROSS-562 FEA-B-CROSS-563 FEA-B-CROSS-564 FEA-B-CROSS-565 FEA-B-CROSS-566 FEA-B-CROSS-567 FEA-B-CROSS-568 FEA-B-CROSS-569 FEA-B-CROSS-570 FEA-B-CROSS-571 FEA-B-CROSS-572 FEA-B-CROSS-573 FEA-B-CROSS-574 FEA-B-CROSS-575 FEA-B-CROSS-576 FEA-B-CROSS-577 FEA-B-CROSS-578 FEA-B-CROSS-579 FEA-B-CROSS-580 FEA-B-CROSS-581 FEA-B-CROSS-582 FEA-B-CROSS-583 FEA-B-CROSS-584 FEA-B-CROSS-585 FEA-B-CROSS-586 FEA-B-CROSS-587 FEA-B-CROSS-588 FEA-B-CROSS-589 FEA-B-CROSS-590 FEA-B-CROSS-591 FEA-B-CROSS-592 FEA-B-CROSS-593 FEA-B-CROSS-594 FEA-B-CROSS-595 FEA-B-CROSS-596 FEA-B-CROSS-597 FEA-B-CROSS-598 FEA-B-CROSS-599 FEA-B-CROSS-600 FEA-B-CROSS-601 FEA-B-CROSS-602 FEA-B-CROSS-603 FEA-B-CROSS-604 FEA-B-CROSS-605 FEA-B-CROSS-606 FEA-B-CROSS-607 FEA-B-CROSS-608 FEA-B-CROSS-609 FEA-B-CROSS-610 FEA-B-CROSS-611 FEA-B-CROSS-612 FEA-B-CROSS-613 FEA-B-CROSS-614 FEA-B-CROSS-615 FEA-B-CROSS-616 FEA-B-CROSS-617 FEA-B-CROSS-618 FEA-B-CROSS-619 FEA-B-CROSS-620 FEA-B-CROSS-621 FEA-B-CROSS-622 FEA-B-CROSS-623 FEA-B-CROSS-624 FEA-B-CROSS-625 FEA-B-CROSS-626 FEA-B-CROSS-627 FEA-B-CROSS-628 FEA-B-CROSS-629 FEA-B-CROSS-630 FEA-B-CROSS-631 FEA-B-CROSS-632 FEA-B-CROSS-633 FEA-B-CROSS-634 FEA-B-CROSS-635 FEA-B-CROSS-636 FEA-B-CROSS-637 FEA-B-CROSS-638 FEA-B-CROSS-639 FEA-B-CROSS-640 FEA-B-CROSS-641 FEA-B-CROSS-642 FEA-B-CROSS-643 FEA-B-CROSS-644 FEA-B-CROSS-645 FEA-B-CROSS-646 FEA-B-CROSS-647 FEA-B-CROSS-648 FEA-B-CROSS-649 FEA-B-CROSS-650 FEA-B-CROSS-651 FEA-B-CROSS-652 FEA-B-CROSS-653 FEA-B-CROSS-654 FEA-B-CROSS-655 FEA-B-CROSS-656 FEA-B-CROSS-657 FEA-B-CROSS-658 FEA-B-CROSS-659 FEA-B-CROSS-660 FEA-B-CROSS-661 FEA-B-CROSS-662 FEA-B-CROSS-663 FEA-B-CROSS-664 FEA-B-CROSS-665 FEA-B-CROSS-666 FEA-B-CROSS-667 FEA-B-CROSS-668 FEA-B-CROSS-669 FEA-B-CROSS-670 FEA-B-CROSS-671 FEA-B-CROSS-672 FEA-B-CROSS-673 FEA-B-CROSS-674 FEA-B-CROSS-675 FEA-B-CROSS-676 FEA-B-CROSS-677 FEA-B-CROSS-678 FEA-B-CROSS-679 FEA-B-CROSS-680 FEA-B-CROSS-681 FEA-B-CROSS-682 FEA-B-CROSS-683 FEA-B-CROSS-684 FEA-B-CROSS-685 FEA-B-CROSS-686 FEA-B-CROSS-687 FEA-B-CROSS-688 FEA-B-CROSS-689 FEA-B-CROSS-690 FEA-B-CROSS-691 FEA-B-CROSS-692 FEA-B-CROSS-693 FEA-B-CROSS-694 FEA-B-CROSS-695 FEA-B-CROSS-696 FEA-B-CROSS-697 FEA-B-CROSS-698 FEA-B-CROSS-699 FEA-B-CROSS-700 FEA-B-CROSS-701 FEA-B-CROSS-702 FEA-B-CROSS-703 FEA-B-CROSS-704 FEA-B-CROSS-705 FEA-B-CROSS-706 FEA-B-CROSS-707 FEA-B-CROSS-708 FEA-B-CROSS-709 FEA-B-CROSS-710 FEA-B-CROSS-711 FEA-B-CROSS-712 FEA-B-CROSS-713 FEA-B-CROSS-714 FEA-B-CROSS-715 FEA-B-CROSS-716 FEA-B-CROSS-717 FEA-B-CROSS-718 FEA-B-CROSS-719 FEA-B-CROSS-720 FEA-B-CROSS-721 FEA-B-CROSS-722 FEA-B-CROSS-723 FEA-B-CROSS-724 FEA-B-CROSS-725 FEA-B-CROSS-726 FEA-B-CROSS-727 FEA-B-CROSS-728 FEA-B-CROSS-729 FEA-B-CROSS-730 FEA-B-CROSS-731 FEA-B-CROSS-732 FEA-B-CROSS-733 FEA-B-CROSS-734 FEA-B-CROSS-735 FEA-B-CROSS-736 FEA-B-CROSS-737 FEA-B-CROSS-738 FEA-B-CROSS-739 FEA-B-CROSS-740 FEA-B-CROSS-741 FEA-B-CROSS-742 FEA-B-CROSS-743 FEA-B-CROSS-744 FEA-B-CROSS-745 FEA-B-CROSS-746 FEA-B-CROSS-747 FEA-B-CROSS-748 FEA-B-CROSS-749 FEA-B-CROSS-750 FEA-B-CROSS-751 FEA-B-CROSS-752 FEA-B-CROSS-753 FEA-B-CROSS-754 FEA-B-CROSS-755 FEA-B-CROSS-756 FEA-B-CROSS-757 FEA-B-CROSS-758 FEA-B-CROSS-759 FEA-B-CROSS-760 FEA-B-CROSS-761 FEA-B-CROSS-762 FEA-B-CROSS-763 FEA-B-CROSS-764 FEA-B-CROSS-765 FEA-B-CROSS-766 FEA-B-CROSS-767 FEA-B-CROSS-768 FEA-B-CROSS-769 FEA-B-CROSS-770 FEA-B-CROSS-771 FEA-B-CROSS-772 FEA-B-CROSS-773 FEA-B-CROSS-774 FEA-B-CROSS-775 FEA-B-CROSS-776 FEA-B-CROSS-777 FEA-B-CROSS-778 FEA-B-CROSS-779 FEA-B-CROSS-780 FEA-B-CROSS-781 FEA-B-CROSS-782 FEA-B-CROSS-783 FEA-B-CROSS-784 FEA-B-CROSS-785 FEA-B-CROSS-786 FEA-B-CROSS-787 FEA-B-CROSS-788 FEA-B-CROSS-789 FEA-B-CROSS-790 FEA-B-CROSS-791 FEA-B-CROSS-792 FEA-B-CROSS-793 FEA-B-CROSS-794 FEA-B-CROSS-795 FEA-B-CROSS-796 FEA-B-CROSS-797 FEA-B-CROSS-798 FEA-B-CROSS-799 FEA-B-CROSS-800 FEA-B-CROSS-801 FEA-B-CROSS-802 FEA-B-CROSS-803 FEA-B-CROSS-804 FEA-B-CROSS-805 FEA-B-CROSS-806 FEA-B-CROSS-807 FEA-B-CROSS-808 FEA-B-CROSS-809 FEA-B-CROSS-810 FEA-B-CROSS-811 FEA-B-CROSS-812 FEA-B-CROSS-813 FEA-B-CROSS-814 FEA-B-CROSS-815 FEA-B-CROSS-816 FEA-B-CROSS-817 FEA-B-CROSS-818 FEA-B-CROSS-819 FEA-B-CROSS-820 FEA-B-CROSS-821 FEA-B-CROSS-822 FEA-B-CROSS-823 FEA-B-CROSS-824 FEA-B-CROSS-825 FEA-B-CROSS-826 FEA-B-CROSS-827 FEA-B-CROSS-828 FEA-B-CROSS-829 FEA-B-CROSS-830 FEA-B-CROSS-831 FEA-B-CROSS-832 FEA-B-CROSS-833 FEA-B-CROSS-834 FEA-B-CROSS-835 FEA-B-CROSS-836 FEA-B-CROSS-837 FEA-B-CROSS-838 FEA-B-CROSS-839 FEA-B-CROSS-840 FEA-B-CROSS-841 FEA-B-CROSS-842 FEA-B-CROSS-843 FEA-B-CROSS-844 FEA-B-CROSS-845 FEA-B-CROSS-846 FEA-B-CROSS-847 FEA-B-CROSS-848 FEA-B-CROSS-849 FEA-B-CROSS-850 FEA-B-CROSS-851 FEA-B-CROSS-852 FEA-B-CROSS-853 FEA-B-CROSS-854 FEA-B-CROSS-855 FEA-B-CROSS-856 FEA-B-CROSS-857 FEA-B-CROSS-858 FEA-B-CROSS-859 FEA-B-CROSS-860 FEA-B-CROSS-861 FEA-B-CROSS-862 FEA-B-CROSS-863 FEA-B-CROSS-864 FEA-B-CROSS-865 FEA-B-CROSS-866 FEA-B-CROSS-867 FEA-B-CROSS-868 FEA-B-CROSS-869 FEA-B-CROSS-870 FEA-B-CROSS-871 FEA-B-CROSS-872 FEA-B-CROSS-873 FEA-B-CROSS-874 FEA-B-CROSS-875 FEA-B-CROSS-876 FEA-B-CROSS-877 FEA-B-CROSS-878 FEA-B-CROSS-879 FEA-B-CROSS-880 FEA-B-CROSS-881 FEA-B-CROSS-882 FEA-B-CROSS-883 FEA-B-CROSS-884 FEA-B-CROSS-885 FEA-B-CROSS-886 FEA-B-CROSS-887 FEA-B-CROSS-888 FEA-B-CROSS-889 FEA-B-CROSS-890 FEA-B-CROSS-891 FEA-B-CROSS-892 FEA-B-CROSS-893 FEA-B-CROSS-894 FEA-B-CROSS-895 FEA-B-CROSS-896 FEA-B-CROSS-897 FEA-B-CROSS-898 FEA-B-CROSS-899 FEA-B-CROSS-900 FEA-B-CROSS-901 FEA-B-CROSS-902 FEA-B-CROSS-903 FEA-B-CROSS-904 FEA-B-CROSS-905 FEA-B-CROSS-906 FEA-B-CROSS-907 FEA-B-CROSS-908 FEA-B-CROSS-909 FEA-B-CROSS-910 FEA-B-CROSS-911 FEA-B-CROSS-912 FEA-B-CROSS-913 FEA-B-CROSS-914 FEA-B-CROSS-915 FEA-B-CROSS-916 FEA-B-CROSS-917 FEA-B-CROSS-918 FEA-B-CROSS-919 FEA-B-CROSS-920 FEA-B-CROSS-921 FEA-B-CROSS-922 FEA-B-CROSS-923 FEA-B-CROSS-924 FEA-B-CROSS-925 FEA-B-CROSS-926 FEA-B-CROSS-927 FEA-B-CROSS-928 FEA-B-CROSS-929 FEA-B-CROSS-930 FEA-B-CROSS-931 FEA-B-CROSS-932 FEA-B-CROSS-933 FEA-B-CROSS-934 FEA-B-CROSS-935 FEA-B-CROSS-936 FEA-B-CROSS-937 FEA-B-CROSS-938 FEA-B-CROSS-939 FEA-B-CROSS-940 FEA-B-CROSS-941 FEA-B-CROSS-942 FEA-B-CROSS-943 FEA-B-CROSS-944 FEA-B-CROSS-945 FEA-B-CROSS-946 FEA-B-CROSS-947 FEA-B-CROSS-948 FEA-B-CROSS-949 FEA-B-CROSS-950 FEA-B-CROSS-951 FEA-B-CROSS-952 FEA-B-CROSS-953 FEA-B-CROSS-954 FEA-B-CROSS-955 FEA-B-CROSS-956 FEA-B-CROSS-957 FEA-B-CROSS-958 FEA-B-CROSS-959 FEA-B-CROSS-960 FEA-B-CROSS-961 FEA-B-CROSS-962 FEA-B-CROSS-963 FEA-B-CROSS-964 FEA-B-CROSS-965 FEA-B-CROSS-966 FEA-B-CROSS-967 FEA