In this study, face/core fatigue crack growth in sandwich X-joints is investigated numerically and experimentally. The work presented here covers Part I of the study which includes an experimental investigation of fatigue crack growth in sandwich X-joints and characterization of the face/core interface of the joints. Sandwich tear test specimens with a face/core debond representing a debonded sandwich X-joint were tested under cyclic loading. Fatigue tests were conducted on the sandwich tear test specimens with H45, H100 and H250 PVC cores and glass/polyester face sheets. The Digital Image Correlation technique was used to locate the crack tip and monitor the crack growth. For the specimens with H45 core, unstable crack growth took place initially. Following the unstable propagation, the crack propagated in the core underneath the resin-rich cell layer approaching the interface. However, the crack did not kink into the interface. For the specimens with H100 core, the crack propagated initially in the core and then returned into the interface and continued to propagate in the interface. For the specimens with H250 core, the crack initially propagated in the core and then kinked into the interface. The interface crack eventually kinked into the face sheet, resulting in large-scale fiber bridging. Finally, mixed mode bending tests were conducted to measure crack growth rates of the face/core interface at mode-mixity phase angles similar to those calculated for the sandwich tear test specimens. The measured crack growth rates have been used in Part II of this study to simulate fatigue crack growth in the sandwich tear test specimens.