

Secrets of a Homicide: The JFK Assassination
**Epipolar Geometric Analysis of Amateur Films Related to
Acoustics Evidence in the John F. Kennedy Assassination**

By Dale K. Myers



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ABOUT THE PROJECT

Secrets of a Homicide: JFK Assassination is a continuing project involving computer analysis of photographic evidence in the infamous 1963 crime by award-winning computer animator Dale K. Myers. Through a series of graphic reports, *Secrets of a Homicide* seeks to educate and enlighten students, scholars and historians by providing a unique geometric and technological perspective on the assassination. The results of the *Secrets of a Homicide* project have been cited in many publications and broadcast by television networks worldwide including ABC News, The BBC, The Discovery Channel, and The History Channel. Graphic reports available on the Internet include: *Computer Reconstruction of the JFK Assassination*, *Badge Man: A Photogrammetric Analysis of Moorman Photograph No.5 of the JFK Assassination*, and *Epipolar Geometric Analysis of Amateur Films Related to Acoustics Evidence in the John F. Kennedy Assassination*. See, www.jfkfiles.com for more information.

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Cover Image

Composite image created from multiple frames from the Robert Hughes film. This is the way the 1979 House Select Committee on Assassinations (HSCA) envisioned Dealey Plaza moments before the shooting. The presidential limousine, motorcycle escorts, and Secret Service follow-up car (background) turn onto Elm Street at the base of the Texas School Book Depository. Motorcycle officer H.B. McLain (foreground) trails the limousine by 237 feet. The committee concluded that McLain arrived at the next intersection in time to transmit the sounds of gunfire over his open microphone. This report demonstrates that the committee's scenario is false and that the HSCA's acoustic evidence of a conspiracy is invalid.

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*"...if it can be shown that there was no vehicle or person with a police radio near the trajectory where I found it to be, then, that is impeaching evidence."*¹

Dr. James Barger, Lead Scientist, BBN, 2001

*"If you could prove to me that there was no police officer in the place where he had to be, you would falsify [the acoustics evidence]."*²

G. Robert Blakey, Chief Counsel, HSCA, 2003

SUMMARY

In 1979, the House Select Committee on Assassinations (HSCA) concluded that there was a "high probability that two gunmen fired at President John F. Kennedy," and therefore, Kennedy was "probably assassinated as a result of a conspiracy."³

Their conclusion, which contradicted the 1964 Warren Commission's conclusion that Lee Harvey Oswald alone killed President Kennedy, was based largely on an acoustical analysis of an eight-second segment of a Dallas police recording made of radio transmissions presumed to have originated from a motorcycle within the presidential motorcade. Although the static-filled recording contained no audible sounds that could be distinguished as being gunshots, two acoustic research groups – James Barger, Scott Robinson, Edward Schmidt and Jared Wolf of Bolt, Beranek and Newman, Inc. (BBN), and later, Mark Weiss and Ernest Aschkenasy of Queens College (WA) – concluded that the recording contained four impulse sounds, which they believed were probable gunshots.

According to these experts, three of the "gunshots" originated from the southeastern-most sixth floor window of the Texas School Book Depository, while a fourth "gunshot" originated from the southeast corner of the stockade fence atop the grassy knoll. The probability of a grassy knoll shot was believed to be 95 percent.⁴

The acoustic experts predicted that the motorcycle with the open microphone was located 120 to 140 feet behind the presidential limousine at the time of the shooting. After a limited review of the photographic record, the HSCA identified the motorcycle officer with the open microphone as Dallas police officer H.B. McLain, who the committee alleged was "in the approximate position of the transmitting microphone, as indicated by the acoustical analysis," and therefore was responsible for transmitting the gunshot sounds.⁵

1. Email group posting from James Barger, April, 2001

2. ABC News, *Peter Jennings Reporting: The Kennedy Assassination – Beyond Conspiracy*, November 20, 2003

3. *HSCA Report*, p.1

4. *Report of the Committee on Ballistic Acoustics*, National Research Council, 1982, p.3

5. *HSCA Report*, p.76

The importance of the HSCA's acoustic evidence cannot be over emphasized. It is the only hard, physical evidence *ever* offered in support of a conspiracy over the course of the nearly four-and-a-half decade assassination debate. Without it, there is no credible reason to believe that anyone other than Lee Harvey Oswald fired shots at the Kennedy motorcade.

It is equally important to recognize that the conclusions of the HSCA acoustic experts hinge on a very basic assumption – a police motorcycle, with an open microphone, was transmitting the sound of the shots from four very specific locations at the time of the assassination. In order for the HSCA's acoustic evidence of conspiracy to have validity, a police motorcycle *must be present* at the four specific locations and times predicted by the acoustic analysis. If there is no motorcycle at the location and times predicted by their analysis, their conclusions are, by default, invalid – plain and simple.

This research paper documents the use of computer technology, epipolar geometry,* and nine amateur 8mm films of the assassination to construct a synchronized photographic record of the shooting and determine the validity of the HSCA's acoustic evidence of conspiracy.

The result is a definitive photographic record of the last 40-seconds of President Kennedy's life that demonstrates that no police motorcycles – including, Officer H.B. McLain's – were near the area designated by the HSCA's acoustic experts, and consequently, the committee's acoustic evidence of a conspiracy in the Kennedy assassination is invalid.

HISTORY

In December, 1976, Gary Mack, the program director at KFJZ-FM radio in Forth Worth, Texas, met with Penn Jones, Jr., the editor of the small town *Midlothian Mirror* newspaper and a leading conspiracy theorist. Mack, who first became interested in the assassination after the March, 1975, ABC television broadcast of the Zapruder film, later wrote, "We were discussing exactly how the assassination occurred. He mentioned to me that radio communications on one of two police channels (actually the main channel) were blocked for five straight minutes beginning just a few seconds before the shots were fired. Most of the Dallas officers were on Channel One, including the officers in the President's motorcade. Several officials and others in the procession were on the second channel, but most of the activity was on channel one. Penn was of the opinion that the communications were jammed on purpose... I asked Penn how this interference occurred. He said apparently someone had left his microphone key depressed and it blocked the channel so no one could get through. I asked where this 'open microphone' was located and he said they had assumed it was within the motorcade because you could hear the motorcycle noise on the Dallas police tape... I told Penn that if the officer's motorcycle was in Dealey Plaza then certainly the sound of the gunshots could be heard on the tape too. For some incredible reason no one had ever thought

*Epipolar geometry describes the geometric relationship between two optical systems viewing the same subject and can be used to locate points or objects in space.

of that fact before. Not once did anyone connected with the Warren Commission, the FBI, CIA or Dallas police ever think to check the tape for gunshots.”⁶

This early conversation – the springboard for the entire acoustic debate that followed – contains a *major* falsehood. Penn Jones, Jr., and Gary Mack, now the curator of the Sixth Floor Museum in Dallas, Texas, made the grievous assumption at that time that some of the officers in the motorcade were communicating over Channel One of the Dallas police radio system. In fact, *all* of the motorcade communications occurred over Channel Two. Consequently, the idea that one of the motorcade motorcyclists might have had an open microphone tuned to Channel *One* during the shooting had no basis in fact. Many premises – all of them *highly* improbable – have since been offered by acoustic evidence supporters to explain this initial false premise.

At the end of their meeting, Jones offered Mack a seventh generation copy of the Dallas police recordings to work from, but the recording proved to be too “muddy” to be of any value.⁷

In January, 1977, Mack received a clearer copy of the police recordings from the grand dame of assassination researchers, Mary Ferrell.⁸ He took the recording to TM Productions and January Sound in Dallas – two audio recording studios – and convinced a few audio technicians to work on the recordings with him. After applying audio filters to remove some of the background noise in the recordings, they found a segment of the tape that contained “little pops and crackles” that “were not repeated anywhere else on the tape.” Mack took the recording home and tried to match the “pops and crackles” to the action seen in the Zapruder film.⁹

By July of 1977, Mack was convinced he could hear seven distinct shots on the recording.¹⁰ Despite the fact that a later HSCA investigation would conclude that the “gunshots” were inaudible to the human ear,¹¹ Mack wrote in *The Continuing Inquiry*, a Penn Jones, Jr. published assassination newsletter, that it was “easy” for him and his technicians to hear seven shots and determine their exact sequence on the tape.

“Without any further processing we heard the first shot: a very loud, sharp crack,” Mack explained. After synchronizing the “gunshots” with the Zapruder film, Mack wrote that the seven shots were fired in the following sequence: “...the first shot corresponded to frame 161, indicating a very early diversionary or signaling shot to set up the ensuing crossfire...Then, 2.7 seconds later, shots two and three struck Kennedy almost simultaneously...probably at [Zapruder frames] #208 and #210...Gunshot number four, just 4.9 seconds after the first...had a hollow, metallic sound...[and] more or less corresponds to frame 250 of Zapruder’s

6. “Conspiracy on Tape,” *Radio & Records*, No.267, February, 2, 1979

7. *Ibid.*

8. “Special Gallery Report on the JFK Assassination,” *Gallery*, July 1979, p.57-1

9. “Conspiracy on Tape,” *Radio & Records*, No.267, February, 2, 1979

10. Mack, Gary, “The Dallas Police Radio: Assassination on Tape!” *The Continuing Inquiry*, Vol.2, No.1, August 22, 1977, pp.2-4; “Conspiracy on Tape,” *Radio & Records*, No.267, February, 2, 1979; “Special Gallery Report on the JFK Assassination,” *Gallery*, July 1979, pp.65-69

11. The HSCA’s acoustic experts determined that there were four inaudible impulse sounds that matched test shots fired in Dealey Plaza.

film...Frame 289...is precisely where the fifth shot is heard, 7 seconds after the first one...[Shots six and seven strike] almost simultaneously at frames 313 and 315...The entire seven-shot sequence took 8.4 seconds..."¹²

Playing back the police recording for TV reporters, Mack used a pointed finger to indicate the precise moment of each "gunshot." He later acknowledged that the segment he thought contained gunshots *preceded* the impulse sounds identified by HSCA acoustic experts as gunshots by two minutes.¹³

On September 17, 1977, the newly formed House Select Committee on Assassinations (HSCA) held a two-day conference of Warren Commission critics in Washington, D.C. HSCA Chief Deputy Counsel G. Robert Blakey later wrote that he wondered about the benefits of such a conference, believing that the majority of critics were only interested in "playing on the emotions of a dispirited American public, writing books and articles for profit, with scant regard for the truth, and we were reluctant to dignify that kind of conduct, even by implication."¹⁴

One of those critics attending the conference was Mary Ferrell, the Dallas researcher who was the source of Mack's copy of the Dallas police recordings. At the end of the first day, Ferrell mentioned Mack's study and that he had found seven shots on the police tape. By the end of the month, Ferrell turned over her copies of the police recordings to the HSCA for further study.¹⁵

In October, 1977, the HSCA contacted the Acoustical Society of America, a professional organization of acoustical engineers and scientists, and asked for recommendations on who was qualified to study the recordings.¹⁶ Five organizations were recommended. At the top of the list was Bolt, Beranek, and Newman, Inc., (BBN) a Cambridge, Massachusetts, firm that had previously studied the eighteen-minute gap in the Watergate tapes, as well as sound recordings of the 1970 Kent State University shooting of students by the Ohio National Guard. BBN pioneered a technique which allowed them to determine the timing and direction

12. Mack, Gary, "The Dallas Police Radio: Assassination on Tape!" *The Continuing Inquiry*, Vol.2, No.1, August 22, 1977, pp.2-4

13. Mack, Gary, "Acoustics as Easy as 1-2-3 . . . 4," *The Continuing Inquiry*, Vol.4, No.8, March 22, 1980, p.1

14. Blakey, G. Robert and Billings, Richard N., *The Plot To Kill The President: Organized Crime Assassinated J.F.K., The Definitive Story*, Times Books, 1981, p.91

15. HSCA Critics Conference Transcript, September 17, 1977, pp.211-213, HSCA RIF 180-10117-10024; Letter, Mary Ferrell to Ann Taylor, February 13, 1978, p.1., HSCA RIF 180-10089-10456; Blakey, G. Robert and Billings, Richard N., *The Plot To Kill The President: Organized Crime Assassinated J.F.K., The Definitive Story*, Times Books, 1981, pp.91-92 [Note: Mack later claimed to be the one responsible for bringing the Dallas police tapes to the attention of the HSCA. Mack believed that his August, 1977, article for *The Continuing Inquiry* prompted an HSCA attorney to telephone him with a week of its publication. ("Special Gallery Report on the JFK Assassination," *Gallery*, July 1979, pp.65-69; "Conspiracy on Tape," *Radio & Records*, No.267, February 2, 1979; Letter, Paul L. Hoch to Mike Ewing and Gary Cornwell, January 17, 1979, p.1, HSCA RIF 180-10105-10362) However, National Archive documents show that Mack wasn't telephoned by HSCA senior staff attorney John Hornbeck until November 21, 1977 (HSCA Outside Contact Report, November 21, 1977, 3:00 p.m., p.1, HSCA RIF 180-10113-10398), a month *after* Mary Ferrell originally told the HSCA about the recordings and three days after Bolt, Beranek, and Newman (BBN) had completed their analysis of her recordings. (HSCA Outside Contact Report, November 17, 1977, 9:00 a.m., p.1, HSCA RIF 180-10113-10396) The reason Hornbeck called Mack was to determine the source of Ferrell's recordings. Hornbeck found that Mack's copies originated with Ferrell.]

16. Acoustic Meeting Notes, October 4, 1977, HSCA RIF 180-10105-10375

of the gunfire. BBN's audio work, *combined with photographs taken at the scene*, allowed prosecutors to establish which guardsmen fired first.¹⁷

BBN scientists told the HSCA that if the audio recording contained gunshots and they had a good quality copy to work from, they could determine how many shots had been fired, the timing of the shots, and the source of the gunfire.¹⁸

However, on November 17, 1977, after an analysis of Mary Ferrell's copies of the Dallas police recordings, BBN reported that the copies had "a very scratchy overlay of needle noise, indicating that it was a very poor or multiple-generation dub of [the original] recording." Consequently, BBN was unable to say for certain whether the recordings did or did not contain the sound of gunshots, as Mack claimed. They would need access to the original Dallas police recordings.¹⁹

Four months later, on March 10, 1978, HSCA investigators located the original Dallas police Dictabelt and Audograph recordings, as well as taped copies of the originals, among the possessions of retired Dallas police lieutenant Paul McCaghren.²⁰

The Dallas police radio traffic was routinely recorded onto thin, plastic belts and disks by two separate dual recording units. Channel One, which handled routine radio traffic, was recorded on a Dictaphone Corporation A2TC, Model 5, belt (or loop) recorder purchased by the department in 1957. Channel Two, which handled special event radio traffic like the presidential motorcade, was recorded on a Gray Corporation "Audograph" flat disk recorder which was bought in the early 1950's. Both dual devices consisted of one unit set to record and a second unit set to take over the recording duties as soon as the first unit was full.²¹

On May 12, 1978, the HSCA asked BBN to analyze the original Dallas police recordings and determine if they contained evidence of gunshots. Dr. James E. Barger, the lead scientist at BBN was less than hopeful of finding gunshots after a preliminary examination of the Channel One recording thought by Mack to contain gunshots. Barger determined that the recording, to the human ear, contained *no audible sounds of gunfire* – in contradiction with Mack's claim that seven shots could be heard. Barger told the HSCA that he was "not hopeful about the prospects of recovering anything from the tape." However, he agreed to clean up the recording and run a series of tests designed to prove that there were *no* gunshots on the tape. He reasoned that if preliminary tests showed that no gunshots were on the tape, there would be no need to conduct additional acoustic tests in Dallas, saving the HSCA time and money. The HSCA agreed.²²

17. HSCA Report, pp.66-67

18. Blakey, G. Robert and Billings, Richard N., *The Plot To Kill The President: Organized Crime Assassinated J.F.K., The Definitive Story*, Times Books, 1981, p.92

19. 8HSCA62; 8HSCA34; HSCA Outside Contact Report, November 17, 1977, p.1, HSCA RIF 180-10113-10396

20. Interview of Paul McCaghren, March 10, 1978, pp.1-2, HSCA RIF 180-10115-10094

21. Bowles, James C., *The Kennedy Assassination Tapes: A Rebuttal to the Acoustical Evidence Theory*, 1979, p.10; 23H832 CE1974

22. 8HSCA34, 62; Outside Contact Report, June 27, 1978, 2:20 p.m., p.1, HSCA RIF 180-10096-10396; Blakey, G. Robert and Billings, Richard N., *The Plot To Kill The President: Organized Crime Assassinated J.F.K., The Definitive Story*, Times Books, 1981, p.93

Two months later, on July 13, 1978, Dr. Barger called the committee and dropped a bombshell – there *was* evidence of three to five gunshots on the police recordings. The HSCA made arrangements to bring Barger to Washington to brief the committee in executive session.²³

For two days, beginning on July 17, 1978, Dr. Barger briefed the HSCA in secret session. He told the committee that what BBN thought might be gunshots were a sequence of “impulse sounds” that appeared on the Channel One recording beginning at about 12:30 p.m. and 47 seconds.²⁴ Barger cautioned that while the loudest “impulse sounds” might be gunfire, they could just as easily be motorcycle engine misfires, ignition system noises, intermittent microphone relay sounds, scratches on the surface of the Dictabelt itself, electrical or mechanical distortions due to components in the communication system, or any number of other non-firearm sources.²⁵ Barger reported that he had subjected the “impulse sounds” BBN had discovered to “five simple but necessary” test questions – Do the sounds occur at the time of the assassination? Are the sounds unique, occurring only at one time and nowhere else on the tape? Do the time intervals between the sounds match other known evidence (chiefly, the Zapruder film)? Does the “shape” of the sounds, as seen in a waveform, resemble the shapes of known gunfire? Is the volume of the sounds similar to that of known gunfire?²⁶ The answer to each of the test questions was, *yes*.²⁷

Consequently, Barger told the committee, a more sophisticated test was required to determine if any of the “impulse sounds” were actually gunfire. He suggested that BBN be allowed to conduct an acoustic reconstruction in Dealey Plaza – site of the 1963 murder – during which test shots would be fired from locations suggested by eyewitness accounts and compared with the “impulse sounds” on the police recording. If any of these “acoustical fingerprints” matched the impulse sounds on the recording, BBN would be able to determine the timing of the shots, the location of the gunman, and the target for each shot fired.²⁸

On Sunday, August 20, 1978, the HSCA investigative team consisting of four committee staff members, seven acoustic experts, a photographic consultant, and 37 Dallas police officers assembled in Dealey Plaza, along with a crowd of about 200 spectators.²⁹

Since it was impractical to fire test shots from every conceivable firing location, BBN chose two sites that had been featured the most in assassination literature – the Texas School Book Depository and the grassy knoll. Dallas police sharpshooters fired Mannlicher-Carcano rifles³⁰ from both locations at four target boxes filled with sandbags at specific locations

23. Outside Contact Report, July 13, 1978, 1:55 p.m., pp.1-2, HSCA RIF 180-10077-10242; Blakey, G. Robert and Billings, Richard N., *The Plot To Kill The President: Organized Crime Assassinated J.F.K., The Definitive Story*, Times Books, 1981, pp.94-95

24. 8HSCA11-12; *HSCA Report*, p.80

25. 8HSCA15

26. 8HSCA70

27. 8HSCA70-79

28. 8HSCA80

29. Blakey, G. Robert and Billings, Richard N., *The Plot To Kill The President: Organized Crime Assassinated J.F.K., The Definitive Story*, Times Books, 1981, p.97

30. A pistol was also fired from the grassy knoll in order to obtain a subsonic acoustic fingerprint from this location. The Mannlicher-Carcano rifle provided a *super-sonic* acoustic fingerprint.

along Elm Street.³¹ Three of those targets were located at positions that matched that of the presidential limousine at Zapruder frames 160, 200, and 313. A fourth target was placed near the Main Street curb where a bullet was known to have ricocheted.³²

To record the test shots, BBN arranged their microphones at eighteen foot intervals along the motorcade route through Dealey Plaza. They used a 14-track recorder to record the gunfire and therefore, were limited to using only twelve microphones at a time (leaving two tracks available for communications); arranged in three separate groups for a total of 36 microphone positions. The combination of microphone positions and multiple test firings provided 432 sound patterns. BBN was confident that *if* the impulse sounds on the Dallas police recording were indeed gunshots, they would be able to predict the position of the motorcycle with the open microphone to within 18 feet of its actual location.³³

Over a five hour period, fifty-seven test shots were fired in Dealey Plaza.³⁴

On August 30, 1978, Dr. Barger called the HSCA and told them that he had completed his preliminary analysis.³⁵ After comparing the 2,592 combinations of echo test patterns obtained in Dallas with the “impulse sounds” on the eight-second sequence of the Dallas police recording, BBN had discovered 15 echo patterns grouped around four periods of time – an indication that four gunshots had been fired in Dallas. The test echo patterns showed that three of the shots were fired from the Texas School Book Depository and one was fired from the grassy knoll. The motorcycle with the open microphone that presumably transmitted the gunshot “sounds” was predicted to be 120 feet behind the presidential limousine.³⁶

On Sunday, September 10, 1978, the day before he was scheduled to testify, Dr. Barger flew to Washington, D.C., and met with HSCA chief counsel G. Robert Blakey, Congressman Floyd J. Fithian of Indiana, and deputy chief counsel Gary Cornwell and explained the process BBN used to reach their conclusion. The men also studied photographs taken at the time of the assassination in an effort to identify the motorcycle with the open microphone, however none of the photos they looked at covered the period of time in question. Blakey promised to “keep looking.”³⁷

The next day, Monday, September 11, 1978, Dr. Barger testified to the committee in public hearings. Statistically, there was 96% chance that the acoustic team had correctly detected

31. 8HSCA96-98; Blakey, G. Robert and Billings, Richard N., *The Plot To Kill The President: Organized Crime Assassinated J.F.K., The Definitive Story*, Times Books, 1981, p.98; Miller, Eric, “Nov. 22 re-enacted: Police fire rifles, pistol in Dealey Plaza,” *Dallas Morning News*, August 21, 1978; Jackson, Margo, E., “Events pertinent to test shooting in Dealey Plaza, August 20, 1978,” *Dallas Morning News*, August 22, 1978, pp.1-7, HSCA RIF 180-10101-10225.

32. Barger, J.E., “Test Plan for Acoustical Reconstruction of Gunfire Events in Dealey Plaza,” August 14, 1978, pp.1-4, HSCA RIF 180-10082-10125; 8HSCA98-99

33. 8HSCA80, 96-97

34. 2HSCA17; Blakey, G. Robert and Billings, Richard N., *The Plot To Kill The President: Organized Crime Assassinated J.F.K., The Definitive Story*, Times Books, 1981, p.98

35. Barger’s final calculations were completed on September 6, 1978.

36. Outside Contact Report, August 30, 1978, 4:40 p.m., p.1, HSCA RIF 180-10105-10337; Blakey, G. Robert and Billings, Richard N., *The Plot To Kill The President: Organized Crime Assassinated J.F.K., The Definitive Story*, Times Books, 1981, p.99; 2HSCA65-69, 89, 92; 5HSCA650-51; see also JFK Exhibit F-370; 8HSCA49,100-02, 106; *HSCA Report*, p.74, footnote 11; 80

37. Blakey, G. Robert and Billings, Richard N., *The Plot To Kill The President: Organized Crime Assassinated J.F.K., The Definitive Story*, Times Books, 1981, p.101

two shots, a 75% chance they had correctly identified three shots, and only a 29% chance they had correctly found four gunshots. According to Barger, the probability that a grassy knoll shot had been fired was only 50-50.³⁸ Barger reiterated what he had told HSCA members the night before, that the acoustic tests were designed “to see if [the Dallas police tape] was statistically likely to have contained the sounds of gunfire,”³⁹ and that the results he obtained were “a potential corroborating force toward other evidence.”⁴⁰ In short, it was up to the HSCA to find additional evidence that either confirmed or refuted the acoustic tests.

As to the location of the motorcycle with the open microphone, Barger testified that at the time of the first shot, his statistical analysis predicted that the open microphone was on Houston Street about 120 feet, plus or minus 9 feet, behind the president’s limousine.⁴¹ When Barger was asked by HSCA chairman Louis B. Stokes whether he had studied “any available photographs or films in order to try and make a more accurate placement of the motorcycle,” Barger said that photographs taken of that area at the time of the shooting *didn’t reveal the presence of any motorcycles*. “We have seen some photographs taken less than 1 minute before the shooting,” Barger said, “and there are motorcycles back there, but there is so much time elapsed between those pictures and the time of the shooting, it wouldn’t help us [place the motorcycle with any more precision].”⁴²

HSCA chief counsel G. Robert Blakey later wrote, “Barger turned out not to be very persuasive. All of the virtues that made him a fine scientist worked against him as a witness. He was too precise. His answers were too qualified. The Committee, the audience, and the press wanted clear-cut answers. When Barger told them the truth, the impact of his testimony was lost.”⁴³

That evening, the HSCA staff decided to ask two Queens College acousticians they had consulted earlier – Mark Weiss and Ernest Aschkenasy – to see if they could refine BBN’s work and come up with better percentages. At first, Weiss and Aschkenasy weren’t optimistic, but after consulting with Dr. Barger, they came up with a mathematical extension of BBN’s efforts that they thought could reduce the element of chance.⁴⁴

On October 24, 1978, the HSCA authorized Weiss and Aschkenasy to study the impulse sounds associated with the shot fired from the grassy knoll. The HSCA reasoned that since this was the only impulse sound that indicated a conspiracy (all other impulse sounds matched test shots fired from the Texas School Book Depository), they could use their limited time more effectively by concentrating on this one impulse sound.⁴⁵

38. 8HSCA107

39. 2HSCA100

40. 2HSCA94

41. 2HSCA65-69, 81

42. 2HSCA92

43. Blakey, G. Robert and Billings, Richard N., *The Plot To Kill The President: Organized Crime Assassinated J.F.K., The Definitive Story*, Times Books, 1981, p.99

44. Blakey, G. Robert and Billings, Richard N., *The Plot To Kill The President: Organized Crime Assassinated J.F.K., The Definitive Story*, Times Books, 1981, p.101

45. 8HSCA4, 114

On December 11, 1978, Weiss and Aschkenasy, along with Dr. Barger, met with HSCA members in executive session and presented their united findings – they could show with refined mathematical techniques that the certainty of a grassy knoll shot was now 95 percent.⁴⁶ In addition, HSCA photographic consultant Robert Groden had uncovered several amateur film clips that showed motorcycle officer H.B. McLain traveling on Main Street and turning onto Houston Street at about the right time. “McLain was our man,” Blakely later wrote.⁴⁷

On December 18, 1978, Dr. Barger, Weiss and Aschkenasy, again met with HSCA members to answer questions. Mark Weiss explained that his refined mathematical technique assumed as given the speed and location of the suspect motorcycle on Elm Street. Representative Harold Sawyer asked, “If that location is “significantly wrong, then all that proceeds from that is subject to the same fallacy. Is that correct?” Weiss replied, “Well, if the location of the motorcycle is not where I found it to be, you will not get a set of predicted echo occurrences which agree in any way with what is observed in the Dallas police tape recording.”⁴⁸

On December 26, 1978, HSCA Deputy Chief Counsel Gary Cornwell asked former committee staff consultant Richard E. Sprague,⁴⁹ a pioneer in the field of electronic computers best known for his intimate knowledge of the photographic evidence in the Kennedy assassination, to help identify the motorcycle with the open microphone. Sprague subsequently examined numerous films and photographs, including those taken by James Altgens, Robert Hughes, John Martin, Jr., Orville Nix, Malcolm Couch, Dave Wiegman, Mark Bell, and Marie Muchmore, and found no motorcycle in the location indicated by the acoustic panel. Sprague called Cornwell the next day and told him, “Gary, I’ve got bad news for you.” Sprague explained that three films alone prove that no motorcycle was near the area predicted by the acoustic evidence. According to Sprague, the Hughes film proved no motorcycle was any closer than 220 to 250 feet from the limousine at the time of the first shot. The Couch and Wiegman films proved that no motorcycle was 120-140 feet behind the limousine at the time of the last shot. Slides which Sprague made proving his findings were picked up later that day for viewing by the HSCA staff in Washington. The next day, a staff member told Sprague his slides didn’t “prove anything one way or another.”⁵⁰

On December 29, 1978, just 5 days before the HSCA’s investigation was scheduled to expire, the committee met for one final day of televised public hearings. In dramatic fashion, Weiss and Aschkenasy faced the cameras and testified, “It is our conclusion that as a result of very careful analysis, it appears that with a probability of 95 percent or better, there was indeed a shot fired from the grassy knoll.”⁵¹

46. Blakey, G. Robert and Billings, Richard N., *The Plot To Kill The President: Organized Crime Assassinated J.F.K., The Definitive Story*, Times Books, 1981, pp.102-103

47. *Ibid.*, p.103; Letter, James E. Barger to Richard E. Sprague, December 26, 1978

48. HSCA RIF 180-10120-10025, HSCA Committee Briefing, December 18, 1978, p.34

49. Sprague, a conspiracy theorist with strong views on the subject, became a photographic advisor to the HSCA when it was first formed and spent the period from November 1976 to July 1977 helping the committee with the photographic evidence.

50. Golz, Earl, “JFK Panel Staff Knew Motorcycle Wasn’t There,” *Dallas Morning News*, January 8, 1979; Sprague, Richard E., *The Taking of America 1-2-3*, Revised Second Edition, 1979, pp.224, 235-236; Letter, Richard E. Sprague to Todd W. Vaughan, February 11, 1982, p.1

51. 5HSCA556

After the acoustic scientists explained their process to the committee, HSCA chief counsel Blakey called Dallas police officer H.B. McLain to testify. McLain, the HSCA believed, was the one responsible for the open microphone.⁵²

McLain identified himself in a series of frames culled from two amateur films. One sequence, from the Dallas Cinema Associates (DCA) film “President Kennedy’s Final Hour,” showed McLain traveling on Main Street a few blocks before reaching Dealey Plaza.⁵³ The second sequence, from a film by Robert Hughes, showed McLain turning from Main onto Houston Street, one block behind the president’s limousine, which had just turned onto Elm Street.⁵⁴ Since the acoustic evidence predicted the motorcycle with the open microphone was about 120 feet behind the president’s limousine at the time of the first shot,⁵⁵ and because McLain was the only motorcycle officer in the area, the HSCA concluded that McLain “would have been in the approximate position of the transmitting microphone, as indicated by the acoustical analysis.”⁵⁶

Dr. James Barger then appeared again before the committee to show his support for Weiss and Aschkenasy’s work. Asked about the lack of photographs or films that verified the acoustic panel’s conclusions, Barger acknowledged that the “major shortcoming” of their acoustic work “was that there was *no evidence that there was a motor vehicle where we had found it to be.*” Barger later conceded that the lack of photographic verification of the acoustic evidence was “a very obvious place from which to attack the analysis.”⁵⁷

Even Blakey acknowledged during his opening narrative remarks that, “If it could be proved that no motorcycle was in the predicted location at the time of the shots, then serious doubt would be raised about the reliability of the acoustics project.”⁵⁸ What Blakey should have said, of course, was that the acoustics evidence would be *destroyed* by such proof.

On Sunday, December 31, 1978, HSCA chairman Louis B. Stokes announced the committee’s judgment in a 17-page report to the Clerk of the House, Edmund L. Henshaw. After six hours of heated debate behind closed doors, the HSCA concluded that “scientific acoustical evidence established a high probability that two gunmen fired at President John F. Kennedy” and that the President was “probably assassinated as a result of a conspiracy. The Committee is unable to identify the other gunman or the extent of the conspiracy.”⁵⁹

Four members of the twelve member HSCA panel – representatives Harold S. Sawyer (R-MI), Robert E. Edgar (D-PA), and Samuel L. Devine (R-OH) – vigorously dissented from the

52. 5HSCA617

53. 5HSCA626 JFK Exhibit F-668

54. 5HSCA626-27 JFK Exhibit F-669-71; 8HSCA102

55. 2HSCA65-69, 89, 92; 5HSCA650-51; see also JFK Exhibit F-370

56. *HSCA Report*, p.76

57. 5HSCA685-86

58. 5HSCA616

59. HSCA Report, p.1; “Rush to Judgment,” *Newsweek*, January 15, 1979, pp.26-27, HSCA RIF 180-10105-10358; Blakey, G. Robert and Billings, Richard N., *The Plot To Kill The President: Organized Crime Assassinated J.F.K., The Definitive Story*, Times Books, 1981, p.106

committee's four shot conclusion.⁶⁰ Representative Harold Sawyer believed that the photographic evidence of a motorcycle needed to validate the acoustic evidence was only suggestive, not *proof* that one actually existed at the predicted times and locations. Sawyer told the press, "I am not myself persuaded by the committee's acoustical findings...That the motorcycle was there does not appear – from my reading of the evidence in the committee's report – to have been certainly established."⁶¹ Representative Robert Edgar said, "We found no evidence to suggest a conspiracy. We found no gunmen or evidence of a gunman. We found no gun, no shells, no impact of shots from the grassy knoll. We found no [frontal] entry wounds...We found no bullets or fragments of bullets that did not belong to the Oswald weapon. And we found little, if any, evidence of partnership with Lee Harvey Oswald. Few credible ear witness accounts back up the marginal findings of our acoustics experts."⁶²

Gary Mack, who had started the ball rolling on the acoustic evidence so heavily relied upon by the HSCA, told a radio industry trade newspaper, "I take great personal pride in the part that I was able to play in all this. As it turns out, I stumbled upon the first hard evidence of any conspiracy, and for that reason I think we are getting closer to the full story."⁶³

On January 4, 1979, just four days after the Stokes statement was released, former Dallas police officer H.B. McLain met with former Dallas police radio dispatch supervisor James C. Bowles, who played the 1963 Dallas police radio recordings for McLain. It was the first time McLain had heard the recordings. After listening to both recorded channels, McLain declared, "Man, there's no way that could have been my mike stuck open!" McLain recalled the conversations recorded on Channel Two (the motorcade communications channel) but had no recollection of the Channel One conversations (those recorded in and around the stuck microphone segments). McLain also pointed out that the sound of the motorcycle with the open microphone indicated that it was traveling way too fast to be part of the motorcade; that the motorcycle with the open microphone never turned on its siren (something McLain insisted he did); and that the sirens heard on the recording appear to be passing a *stationary* microphone, not one catching up with the motorcade two minutes after the shooting, as the HSCA claimed.⁶⁴

Concluding his own investigation into the sounds heard on the Dallas police recordings in 1979, James C. Bowles wrote a 214-page report on the acoustic evidence and the HSCA's handling of it. In it, he blasted the HSCA's contention that a voice-grade recording system was capable of transmitting and recording non-audible N-waves created by gunshots; pointed out the absence of known sounds related to the motorcade on the recordings; and offered strong evidence that the motorcycle with the open microphone was at or near the Trade Mart, and *not* in the motorcade.⁶⁵

60. HSCA Report, pp.491-511

61. Wicker, Tom, "Assassinations report has two important sidelights," *Detroit Free Press*, July 23, 1979

62. "Judgment rushed on JFK 'plot?'" *The Flint Journal*, March 24, 1979

63. "Conspiracy on Tape," *Radio & Records*, No.267, February 2, 1979

64. Bowles, James C., *The Kennedy Assassination Tapes: A Rebuttal to the Acoustical Evidence Theory*, 1979, pp.30-32; "Cop denies JFK gunshot tape," *Detroit Free Press*, January 6, 1979

65. Bowles, James C., *The Kennedy Assassination Tapes: A Rebuttal to the Acoustical Evidence Theory*, 1979, 214 pages, plus appendices

On January 30, 1979, ten of the nation's leading conspiracy theorists met in New York at a JFK assassination symposium sponsored by *Gallery* magazine. During that conference, three of the attendees – Gary Mack, Jack White, and Robert Groden – announced that they had found the photographic verification of the acoustic evidence that the HSCA had been looking for.⁶⁶ The evidence was an amateur film made by Elsie Dorman which, according to Mack, White, and Groden, showed motorcyclist McLain at the Elm and Houston corner at the time of the first shot; exactly as the HSCA's acoustic panel had predicted.⁶⁷ Groden subsequently submitted frames from the Dorman film to the HSCA;⁶⁸ and while the HSCA emphasized that they did not rely upon Groden's new photographic evidence to draw their final conclusions, their report *does* say that the Dorman frames “supported the committee's conclusion.”⁶⁹

On March 3, 1979, former HSCA photographic consultant Richard E. Sprague wrote a letter to representative Harold Sawyer condemning Groden's so-called photographic verification of the acoustic evidence. Sprague wrote that the “motorcycle location [the acoustic experts] came up with is provably wrong...Elsie Dorman's movie taken from the fourth floor of the [Depository], proves [along with the Wiegman and Couch film] that there was no motorcycle at all, where Weiss, Barger and Aschkenasy say it had to be...”⁷⁰

Sprague also condemned the HSCA's use of the Robert Hughes film as evidence that McLain was in approximately the correct position to transmit the sounds of gunfire. Sprague wrote that McLain couldn't possibly have covered the 170 foot distance between his last known position shown in the Hughes film and the position dictated by the acoustic evidence in the 3.5 seconds that Sprague estimated McLain would have had available to him.⁷¹

On January 7, 1980, Sprague wrote to U.S. Attorney General Benjamin R. Civiletti asking for an opportunity to meet with him and show him photographic evidence that disproved the HSCA's acoustic analysis. Sprague explained that “a few days before the committee's final hearings on the acoustical evidence, which eventually led them to a conclusion of conspiracy, I called to their attention some important photographic evidence. This evidence proves that the acoustical analysis by the committee's outside consultants at Bolt, Beranek and Newman; and by Professors Aschkenasy and Weiss, is faulty. I called this faulty analysis to the attention of the outside consultants, the committee's staff, and the committee's members, both before the last hearings and during the hearings, as well as during the period when the staff was working on the final report. All of them ignored this evidence and you will find no mention of it in the final report or in Volume VI of the appendix to the report covering the photographic evidence.”⁷²

66. “Special Gallery Report on the JFK Assassination,” *Gallery*, July 1979, pp.64-68; Letter, Gary Mack to Richard E. Sprague, April 1, 1980, pp.3-4, Sprague Collection, National Archives

67. “Special Gallery Report on the JFK Assassination,” *Gallery*, July 1979, pp.68-12

68. 5HSCA702-20

69. *HSCA Report*, p.75 footnote 12

70. Letter, Richard E. Sprague to Harold S. Sawyer, March 3, 1979, pp.1-2, Sprague Collection, National Archives

71. Letter, Richard E. Sprague to Norman Ramsey, April 7, 1982, p.3, Sprague Collection, National Archives [Note: The actual amount of time available to McLain according to this study was just 0.55 seconds.]

72. Letter, Richard E. Sprague to Benjamin R. Civiletti, January 7, 1980, p.1, DOJCD RIF 186-10001-10067

On March 11, 1980, Sprague met with two Justice Department attorneys and four members of the FBI's Technical Services Division. Sprague presented his photographic evidence. Included were the photographs and films of James Altgens, Dave Wiegman, and Malcolm Couch, which demonstrated that McLain was "more than 250 feet behind JFK when the shots were fired."⁷³ By the end of the meeting, the FBI and Justice Department officials were "convinced" that McLain was nowhere near the location necessary to validate the acoustic evidence.⁷⁴

In early April, 1980, Gary Mack, who instigated the HSCA's acoustic study, scolded Sprague, calling his efforts to undermine the acoustic evidence "rather foolish," adding, "The real net result, Dick, is that you've made some serious errors that reflect strongly on your credibility." Mack countered Sprague's arguments by claiming that McLain had six to seven seconds to cover the 170 foot distance on Houston Street, not the 3.5 seconds estimated by Sprague; that the Dorman film showed McLain arriving at the time of the *second* shot,⁷⁵ not well after the last as claimed by Sprague; and that a new study of the Zapruder film showed McLain at the corner of Elm and Houston at Zapruder frame 179 (i.e., the period between the first and second shots).⁷⁶ All three of Mack's assertions later proved false.

In the fall of 1980, at the request of the U.S. Department of Justice, the National Research Council established the Committee on Ballistic Acoustics (CBA) to review the HSCA's acoustic findings and methodology. The CBA, led by Harvard University professor Norman F. Ramsey, included eleven other top scientists: Luis W. Alvarez of the Lawrence Berkeley Laboratory at the University of California; Herman Chernoff, Massachusetts Institute of Technology; Robert H. Dicke, Princeton University; Jerome I. Elkind, Xerox Palo Alto Research Center; John C. Feggeler, Bell Telephone Laboratories; Richard L. Garwin, IBM Corporation; Paul Horowitz, Harvard University; Alfred Johnson, National Laboratory Center; Robert A. Phinney, Princeton University; Charles Rader, Massachusetts Institute of Technology; and F. William Sarles, Trisolar Corporation.⁷⁷

On March 4, 1981, on the heels of an FBI report critical of the HSCA acoustic panel's conclusions, Dr. James Barger wrote a letter to Louis Stokes, former chairman of the HSCA, stating, "The most meaningful and the most direct method of verifying whether we have proved that the impulse patterns on the DPD recording are caused by gunfire in Dealey Plaza is to examine independent evidence about the motorcycle trajectory and about the shot timing sequence that our analysis revealed...The HSCA did find that both the motorcycle trajectory and the shot sequence we found were consistent with independent photographic evidence."⁷⁸ Later in the letter, Barger adds, "...photographic evidence was found by the HSCA that showed a motorcycle on the [trajectory] that we had chosen."⁷⁹

73. Letter, Richard E. Sprague to Jeffrey Fogel, March 18, 1980, p.1, attachment to FBI RIF 124-10164-10158

74. Letter, Richard E. Sprague to Norman Ramsey, April 7, 1982, pp.1, 3, Sprague Collection, National Archives

75. This was a revision of Mack's 1979 claim that the Dorman film showed McLain arriving at the time of the *first* shot.

76. Letter, Gary Mack to Richard E. Sprague, 4-1-80, p.1-2, 4, Sprague Collection, National Archives

77. *Report of the Committee on Ballistic Acoustics*, National Research Council, 1982, pp.ii, 4

78. HSCA RIF 186-10006-10053, Letter, James E. Barger to Louis Stokes, March 4, 1981, p.2

79. *Ibid*, p.5

In fact, the HSCA was never able to confirm McLain's presence at the locations predicted by Barger's analysis, nor did Barger have any first hand knowledge about such photographic validation.⁸⁰

On January 31, 1982, the CBA members met for the first time and compared notes from the independent studies they had been conducting since the committee's inception. By the end of the day, the group was convinced that the HSCA acoustic panel's methods were so faulty that it rendered their acoustic evidence of a conspiracy useless.⁸¹

On March 2, 1982, Gary Mack wrote a letter to CBA physicist Norman Ramsey explaining that he was aware of new photographic evidence that showed H.B. McLain's motorcycle at the time and location predicted by the HSCA acoustic analysis, thereby validating the acoustic evidence. This time the "evidence" turned out to be Zapruder frame Z183 which reportedly showed McLain's motorcycle between shot positions 1 and 2. Mack wrote, "HSCA Assistant Staff Counsel Gary Cornwell spotted [McLain] while reviewing the film with HSCA Photo Consultant Robert Groden in Fall, 1978. Groden concurred with Cornwell's observation, and is now preparing a new print for study."⁸² Neither Groden nor Cornwell ever mentioned their finding publicly. Cornwell later denied the observation.⁸³ The object thought to be McLain is actually a 1963 Mercury Comet convertible carrying Dallas Mayor Earle Cabell and his party.

On May 14, 1982, the CBA released their final report which concluded, based partially on the work of Ohio percussionist Stephan N. Barber, that the HSCA's acoustic work was seriously flawed and that "the previously analyzed sounds were recorded about one minute after the assassination and, therefore, too late to be attributed to assassination shots."⁸⁴

In a February 18, 1983, letter to G. Robert Blakey, Dr. James Barger agreed that the NAS-CBA report seemed to show "that the sounds that we connected with gunfire were made about a minute after the assassination shots were fired." However, Barger noted that the recording used by the CBA contained "some enigmatic features" that raise "doubt about the time synchronization of events on that recording." Therefore, Barger concluded, there is some doubt as to whether the NAS-CBA had proven that the acoustic evidence was invalid. Barger suggested that further analysis was needed and suggested a number of studies, including, a "photographic examination of McLain's trajectory." Barger wrote, "It is important to compare our best photographic estimates of McLain's trajectory with our best acoustical estimates... We understand that further work has been done here,⁸⁵ but not having seen it, we don't know if an adequate analysis has been done."⁸⁶

80. Email group posting from James Barger, April, 2001

81. *Report of the Committee on Ballistic Acoustics*, National Research Council, 1982, pp.4-5, 17

82. Letter, Gary Mack to Norman Ramsey, March 2, 1982, p.1 [Note: Mack later claimed that McLain can be seen in Zapruder frames Z179-180, and Z188, 189, and 194. (*Coverups!*, No.6, January, 1983, pp.1-2)]

83. Telephone interview of Gary Cornwell, 1998

84. *Report of the Committee on Ballistic Acoustics*, National Research Council, 1982, p.2; Letter, C.K. Reed to Stephan Barber, November 17, 1980; Letter, Norman F. Ramsey to Steve Barber, October 8, 1981

85. A reference to observations made by Gary Mack, as reported in 1982 and 1983.

86. Letter, Dr. James E. Barger to G. Robert Blakey, February 18, 1983, pp.1-6

In April, 1988, Richard E. Sprague's photographic evidence that motorcycle officer H.B. McLain was not where acoustic experts had predicted was resurrected in an article published in Bob Cutler's *Grassy Knoll Gazette*. Researcher Todd W. Vaughan, who had been corresponding with Sprague, noted that the Robert Hughes film and the Zapruder film both showed the fifth car in the motorcade, the Vice-Presidential Secret Service Follow-Up car, making its turn from Houston onto Elm Street. Using the Secret Service car as a synchronization point, Vaughan concluded, after "eyeballing" the two films, that at the time of the first shot McLain was 230 feet from the position dictated by the HSCA's acoustic evidence and therefore couldn't possibly have been in a position to transmit the sound of gunshots.⁸⁷

In a July, 1990, article published in Jerry Rose's *The Third Decade*, researcher Sim Heninger made a similar observation by also "eyeballing" the Hughes and Zapruder films. Heninger wrote that the Hughes film "actually proves that McLain was barely past the intersection of Houston and Main Streets when the shooting began." Heninger reached his conclusion after observing that the fifth car in the motorcade, the Vice-Presidential Secret Service Follow-Up car, could be seen turning the corner from Houston onto Elm Street in both films, and consequently the synchronization of both films seemed to show McLain "300 feet from where the open microphone had to have been." Heninger also pointed out that the Dorman film showed McLain arriving at the Elm and Houston corner "after the head shot," not at the time of the first shot as Robert Groden had told the HSCA.⁸⁸

On November 20, 1997, assassination researcher Greg Jaynes presented the same hypothesis as Vaughan and Heninger to a gathering of researchers sponsored by JFK/Lancer. Jaynes told the attendees that the Hughes film segment showing McLain at the corner of Main and Houston synchronized to the Zapruder film "around frame 160 plus," and that McLain couldn't have been in a position to transmit the "impulse sounds" thought to be gunshots by the HSCA acoustic experts. Jaynes also noted that the Dorman film showed McLain arriving at the location designated by the acoustic experts as the first and second shot positions well after the shooting had ended. Jaynes' presentation, which also relied on "eyeballing" the Zapruder, Hughes and Dorman films, was later published on the Internet. Similar observations have appeared on the Internet in more recent years. However, none of these Internet reports have offered a comprehensive scientific analysis or a definitive conclusion.⁸⁹

In a 2001 email message, Barger wrote that he had never personally seen any films relating to the acoustics evidence, adding, "I limited my work for HSCA to analysis of the police radio channel recordings. At the time I presented my findings, several Congressmen asked me how

87. Vaughan, Todd W., with Cutler, Bob, "Where Was H.B. McLain When the First Shot Was Fired in Dealey Plaza?" *The Grassy Knoll Gazette*, IV/88, Vol.12, #2, April, 1988, pp.3-7; Letter, Richard E. Sprague to Todd W. Vaughan, August 2, 1981, pp.1-2; Letter, Todd W. Vaughan to Richard E. Sprague, February 5, 1982, p.1; Letter, Richard E. Sprague to Todd W. Vaughan, February 11, 1982, p.1; Letter, Richard E. Sprague to Todd W. Vaughan, February 22, 1986, pp.1-4

88. Heninger, Sim, "No McLain, No Motorcycle, No Microphone: The Assassination Films Disprove the Assassination Tapes," *The Third Decade*, Vol.6, No.5, July, 1990, pp.14-17

89. Jaynes, Greg, "H.B. McLain: Not in position to record impulses ala BBN," *The Scene of the Crime*, November 20, 1997; Internet archived source: <http://mcadams.posc.mu.edu/jaynes>; Seaton, Paul, "An Investigation of H20," August 5, 2004; Internet source: <http://www.paulseaton.com/jfk/acoustics/houston/houston.htm>; Russ, Michael, "Synchronizing the Zapruder Film and the Hughes Film," Internet source: <http://www.geocities.com/jfkinf04/sync/sync.htm>.

they were to interpret my results – since I presented them in probabilistic form. I told them that it was up to them to look for corroborating or impeaching independent (of my analysis) evidence. I mentioned several kinds of independent evidence that would corroborate my findings. One of these was, of course, whether they could find a vehicle or person with a police radio near where I had found it. I remember Bob Blakey told me that they had found such evidence, but I don't remember the name of the person who's film was thought to contain this evidence.⁹⁰ I gather from the [email] traffic I've seen...that this evidence is in dispute - at least between some of you. Well, it's an important question, because if it can be shown that there was no vehicle or person with a police radio near the trajectory where I found it to be, then, that is impeaching evidence.”⁹¹

In March, 2001, *Science & Justice*, a quarterly publication of Britain's Forensic Science Society, published a paper by Donald B. Thomas, an entomologist and part-time assassination researcher working for the U.S. Department of Agriculture's Subtropical Agricultural Research Laboratory in Weslaco, Texas. Thomas became convinced of a conspiracy in the Kennedy assassination after viewing Oliver Stone's 1991 motion picture, *JFK*. In his *Science & Justice* published paper, Thomas claimed that the CBA report was flawed and that a statistical review of the HSCA acoustic work confirmed their findings and elevated the probability of a grassy knoll shot from 95 to 96%. Thomas also suggested that five shots, not four as the HSCA had concluded, had been fired in Dealey Plaza.⁹²

Former HSCA chief counsel G. Robert Blakey, eager to embrace any study critical of the CBA's devastating critique of his committee's findings, called Thomas' study “an honest, careful, scientific examination of everything we did, with all the appropriate statistical checks.”⁹³

However, eight months after his findings made worldwide news, Thomas acknowledged to a small group of assassination researchers at a conspiracy conference that his objection to part of the CBA's hypothesis were “largely blown away” after he examined a statistical analysis of a more complete version of the Dallas police recording which he had recently gained access to – the same recording used by the CBA 19 years earlier. Thomas emphasized, however, that his acknowledgment shouldn't be construed to mean that he believed that the CBA hypothesis was correct, merely that the CBA hypothesis was “now plausible.”⁹⁴ Thomas went on to offer a number of arguments which buttressed his original *Science & Justice* paper which concluded that five shots were fired in Dealey Plaza and that the fourth shot, fired from the grassy knoll, was the fatal head shot.

In 2003, Medstar Television and Court-TV commissioned Robert Berkovitz of Sensimetrics Corporation to re-examine the acoustic evidence using the latest computer technology for a

90. A reference to the film of Robert J.E. Hughes, Jr.

91. Email group posting from James Barger, April, 2001

92. Thomas, D.B., “Echo correlation analysis and the acoustic evidence in the Kennedy assassination revisited,” *Science & Justice* 2001, Vol.41, No.1, p.21-32

93. Lardner, Jr., George, “Study Backs Theory of ‘Grassy Knoll,’ New Report Says Second Gunman Fired at Kennedy,” *The Washington Post*, March 26, 2001, p.A3

94. Thomas, Donald B., “Hear No Evil: The Acoustical Evidence in the Kennedy Assassination,” presented on 11/17/01 in Dallas, Texas, p.13; O'Dell, Michael, “The acoustic evidence in the Kennedy assassination,” November 9, 2003, Internet source: <http://mcadams.posc.mu.edu/odell>

forthcoming 40th anniversary television special. Berkovitz concluded that the CBA was correct in their conclusion after all; that the impulse sounds deemed to be gunshots by the HSCA acoustic teams were actually recorded about one minute after the assassination, and therefore, too late to be assassination shots.⁹⁵

Berkovitz' 2003 work for Court TV was immediately challenged by Donald Thomas. Thomas charged in an Internet-posted rebuttal that Berkovitz' "lack of familiarity with the evidence in the case, and perhaps a lack of time, resulted in a lackadaisical study."⁹⁶

On November 20, 2003, ABC television broadcast *Peter Jennings Reporting: The Kennedy Assassination – Beyond Conspiracy*, a two hour 40th anniversary look at the crime of the century. The ABC News special featured sequences from Dale K. Myers' computer reconstruction of the shooting as well as the conclusions he had reached after conducting an epipolar geometric analysis of amateur films related to the acoustic evidence. Myers concluded that H.B. McLain's motorcycle was 174 feet from the location predicted by the HSCA' acoustic experts at the time of the first shot and that the acoustic evidence of a conspiracy was invalid.⁹⁷ His photographic work on the acoustics issue was ignored by conspiracy proponents and arguments for and against the validity of the acoustic evidence reverted to "acoustic" questions.

In early 2006, *Science & Justice* published a research paper by physicists R. Linsker, Richard L. Garwin, Herman Chernoff, Paul Horowitz, and Norman F. Ramsey; three of whom were distinguished members of the 1982 Committee on Ballistic Acoustics (CBA). The scientists rebutted entomologist Donald Thomas' original 2001 thesis as well as his subsequent critiques. The physicists wrote that their paper "identifies serious errors in the Thomas paper and corrects errors in the [CBA] report. We affirm the earlier conclusion of the [CBA] report that the alleged 'shot' sounds were recorded approximately one minute after the assassination."⁹⁸

In late 2006, *Science & Justice* published a letter from Donald Thomas seeking to rebut the critique of the eminent physicists. Thomas claimed that the conclusions of Linsker et al. relied "more on assumptions than on data."⁹⁹

However, in a scathing response to Thomas, published in *Science & Justice*, physicists R. Linsker, Richard L. Garwin, Herman Chernoff, and Norman F. Ramsey demonstrated that it was Thomas' argument "that relies more on assumptions than on data." The scientists showed that Thomas continues to draw conclusions based on unreliable dispatcher annotations; misunderstands and misrepresents the physicists' analysis; and wrongly claims that their analysis supports his conclusions.¹⁰⁰

95. Berkovitz, Robert, "Searching For Historic Noise: A Study of a Sound Recording Made on the Day of the Assassination of President John F. Kennedy," November 22, 2003, p.30

96. Thomas, D.B., "Impulsive Behavior: The CourtTV - Sensimetrics Acoustical Evidence Study," 2003

97. ABC News Special, *Peter Jennings Reporting: The Kennedy Assassination – Beyond Conspiracy*, ABC Television Network, November 20, 2003

98. R. Linsker, R.L. Garwin, H. Chernoff, P. Horowitz, and N.F. Ramsey; "Synchronization of the acoustic evidence in the assassination of President Kennedy," *Science & Justice* 2001, Vol.45, No.4 (2005) p.207

99. Thomas, Donald B.; "Correspondence," *Science & Justice* 2006, pp.1-3

100. R. Linsker, R.L. Garwin, H. Chernoff, and N.F. Ramsey; "Correspondence," *Science & Justice* 2006, pp.1-6

Despite the tremendous weight of credible voices who have denounced the HSCA's acoustic work acoustically over the years, the thin voices of a few skeptics, like Thomas, continue to find an audience.

The innumerable errors in Thomas's work are abundantly evident to the scientific community, but laypersons can't seem to take the time to wade through them. There is, however, an easily accessible method of resolving the debate over the validity of the acoustic evidence *photographically*.

A NEW WAY OF LOOKING AT THE ACOUSTIC EVIDENCE

The conclusions of the HSCA acoustic experts hinge on a very basic assumption – a police motorcycle, with an open microphone, was transmitting the sound of the shots from four very specific locations at the time of the assassination. Those locations were predicted based on the close correlation of sound-impulses detected in the original 1963 police recordings, which acoustic experts believed were gunshot echo patterns, and actual gunshot echo patterns recorded during test firings conducted in Dealey Plaza in 1978.

It cannot be over emphasized that there are *no audible gunshot sounds* on the Dallas police recordings – a major flaw in the HSCA's acoustic theory according to Dallas police radio dispatch supervisor James C. Bowles, who wrote in his critical 1979 report that police shootings have been recorded in other instances and the gunshots are easily heard.

In order for the acoustic analysis to be correct and valid, a police motorcycle *must actually exist* at the four specific locations and times predicted by the acoustic analysis. Consequently, the assumed position of the motorcycle is at the heart of the acoustic analysis. All of the conclusions about the timing and source of the shots, as set forth by Bolt, Beranek and Newman, Inc. (BBN); Mark Weiss and Ernest Aschkenasy of Queens College (WA); and later by Donald B. Thomas, particularly, that one shot was fired from the grassy knoll and therefore there was a conspiracy to assassinate President Kennedy, stem from that assumption. If there is no motorcycle at the location and times predicted by their analysis, their conclusions are, by default, invalid.

In an effort to resolve the continuing debate over the validity of the acoustic evidence in the Kennedy assassination in a manner that would be obvious even to those who can't fathom the CBA report or other continuing acoustic studies, a re-examination of the photographic evidence was undertaken to determine whether or not H.B. McLain's motorcycle (or any police motorcycle for that matter) was in the position predicted by the HSCA acoustic experts.

The study involved using a computer model of Dealey Plaza to geometrically synchronize nine amateur films that captured portions of the motorcade's journey through the plaza.

The result, which was presented to ABC News in 2003 and is detailed here for the first time, is a definitive, reconstructed photographic record that reveals the precise location of the pertinent motorcade vehicles at the time of the shooting. This conclusive record demonstrates that no police motorcycles – including, Officer H.B. McLain’s – were near the area designated by the HSCA’s acoustic experts, and consequently, the committee’s acoustic evidence of a conspiracy in the Kennedy assassination is invalid.

A PHOTOGRAPHIC APPROACH

Nine amateur 8mm films documenting the presidential motorcade’s journey through Dealey Plaza were chosen for the photographic analysis portion of this project. They are the films of:

- (1) Robert Hughes
- (2) Marie Muchmore
- (3) Elsie Dorman
- (4) Orville Nix
- (5) Tina Towner
- (6) F.M. Mark Bell
- (7) John Martin, Jr.
- (8) Charles Bronson
- (9) Abraham Zapruder

The most famous of these is Abraham Zapruder, who is the only photographer to capture the entire shooting sequence.

The nine other amateur photographers, each armed with an 8mm film camera, captured portions of the 32-second period proceeding the shooting, the shooting itself, and some of the events that followed. Many of the sequences overlap and all are very brief - less than five seconds in length.

Because these multiple, fragmentary amateur films collectively capture a single event, it is possible to synchronize all of these films together to reconstruct a continuous record of the original event.

Two films in particular are of prime importance with regard to the acoustic question - the Hughes film and the Zapruder film.

The Hughes film depicts motorcycle officer H.B. McLain, who the HSCA claimed was the motorcycle officer with the open microphone. The Zapruder film documents the shooting sequence.

By determining the relationship between these two films, it is possible to establish McLain's position during the shooting sequence, and therefore, determine whether McLain was, as the HSCA claimed, near the corner of Elm and Houston Streets at the time of the first shot, or whether any other motorcycles were there; and hence, establish the validity of the acoustic evidence.

SYNCHRONIZATION ISSUES

Unlike professional motion picture cameras, the amateur 8mm cameras used to record the Kennedy motorcade were not electronically synchronized nor were they motor-driven. Each of the nine amateur cameras in this study was spring wound resulting in frame rates that could vary by 3% depending on how tightly the operator had wound the spring before filming, how long the camera was in continuous operation, and several other factors, all of which contributed to the camera's functionality. Consequently, the film footage these cameras produced will never exactly match each other frame-for-frame.

Even when two spring wound cameras are running simultaneously, one camera will always be exposing frames a millisecond before or after its counterpart. For purposes of this analysis, those variable milliseconds will make little or no difference.

In synchronizing the amateur films for this project, an error ratio of plus-or-minus (+/-) one frame (approximately one tenth of a second) was deemed acceptable, and therefore considered synchronous.

In order to achieve synchronicity between amateur cameras running at variable frame rates it was necessary to first determine each camera's average operational frame rate.

ESTABLISHING A CLOCK

Of all the amateur films of the Kennedy assassination, the film made by Abraham Zapruder has received the most scrutiny. In 1964, the FBI laboratory conducted a detailed examination of Zapruder's 8mm camera, a Bell & Howell Zoomatic Director Series, Model 414PD. ^[Exhibit 1]

The FBI determined through testing that Zapruder's camera ran for 60 seconds when fully wound and that the "normal run speed" was an average of 18.3 frames-per-second (fps). The FBI tests showed that this average speed varied by approximately 3%, or about 1 frame.¹⁰¹

101. The FBI lab reported on December 20, 1963, that the "normal run speed" of Zapruder's camera was 18.3 frames per second (fps). At the end of January 1964, the Commission requested that the FBI check the variation in the speed of the camera when the spring was fully wound and when it had run down. Subsequent tests (at ten second intervals) showed that during the first ten seconds the camera ran at an average speed of 18.0 to 18.1 fps, increased to 18.3 to 18.5 fps during the next 20 seconds, decreased to 18.1 fps for ten seconds, and finished the final 20 seconds at a speed of 17.6 to 17.9 fps. Since the Zapruder film was exposed during the first half of the camera's run, the FBI ignored the test figures recorded during the final 20 seconds. The remaining figures showed an average speed of 18.3 fps.



Exhibit 1. Zapruder's Model 414PD Bell & Howell Zoomatic Director Series 8mm camera

The FBI also examined the amateur cameras used by Orville O. Nix, Sr., and Mrs. Marie Muchmore. In early 1964, the FBI reported that the Keystone Auto-Zoom Model K-810 8mm movie camera owned by Orville Nix and the Keystone K-7 zoom lens 8mm movie camera used by Marie Muchmore both had an average running speed of 18.5 frames/second.¹⁰²

While the FBI did examine the film made by Robert Hughes, they did not conduct any tests on the Hughes camera to determine its average running speed, nor were any other amateur film cameras studied to determine their running speed.

Because of the unique tests conducted on Zapruder's 8mm Bell & Howell camera, and the fact that the Zapruder film is the only film to show the entire shooting sequence, the Zapruder film was chosen as the primary clock for this project.

The running speeds of all other amateur cameras in this study are therefore considered relative to Zapruder's average camera speed of 18.3 frames-per-second.

102. Trask, Richard B., *Pictures of the Pain*, Yeoman Press, 1994, pp.190, 201, 206

FILM PREPARATION

Each of the nine amateur films used in this analysis was prepared from original sources.¹⁰³

The original 8mm film footage produced by the nine photographers had been transferred to professional video tape by various sources. The speed at which the original films were transferred to video tape was established by “eyeballing” the film footage to see “what looked most natural.” This subjective approach resulted in two potential problems.

First, the transfer rates that were ultimately used had no relationship to the actual speed of the recording camera. These transfer rates varied between 16 and 20.2 frames-per-second (fps). Second, the conversion of film rates of 16 - 20 fps to a standard NTSC video rate of 29.97 fps resulted in redundant (i.e., multiple copies of a single frame) and blended frames (i.e., two adjacent film frames blended to produce a third “non-existent” frame). Redundant and blended frames are artifacts of all film to video transfers and are not peculiar to amateur films of the Kennedy assassination.

Before beginning an analysis of these films for this project, new digital masters with a 1:1 relationship with their original film counterparts were created for all nine amateur films under discussion. This was accomplished by transferring the video tape masters to computer hard drives, converting the video sequences to numbered frame sequences, eliminating all redundant and blended frames, and renumbering the sequences. ^[Exhibit 2]

The renumbering process followed the numbering standard used by the Warren Commission to identify individual frames of the Zapruder film (i.e., the first frame depicting scenes shot in Dealey Plaza was number 001.) All of the frame numbers referred to in this document, except where otherwise noted, reflect this renumbering process.

DETERMINING FRAME RATES

In order to establish synchronicity between all of the amateur films in this project, it was necessary to determine the average frame rate of each untested amateur camera relative to the known average frame rate of Zapruder’s camera. This average should fall within the normal run-time range (16-24 fps) that amateur cameras of the era were capable of operating at.

103. With the exception of the F.M. “Mark” Bell, and John Martin, Jr., films, which used the best available sources.

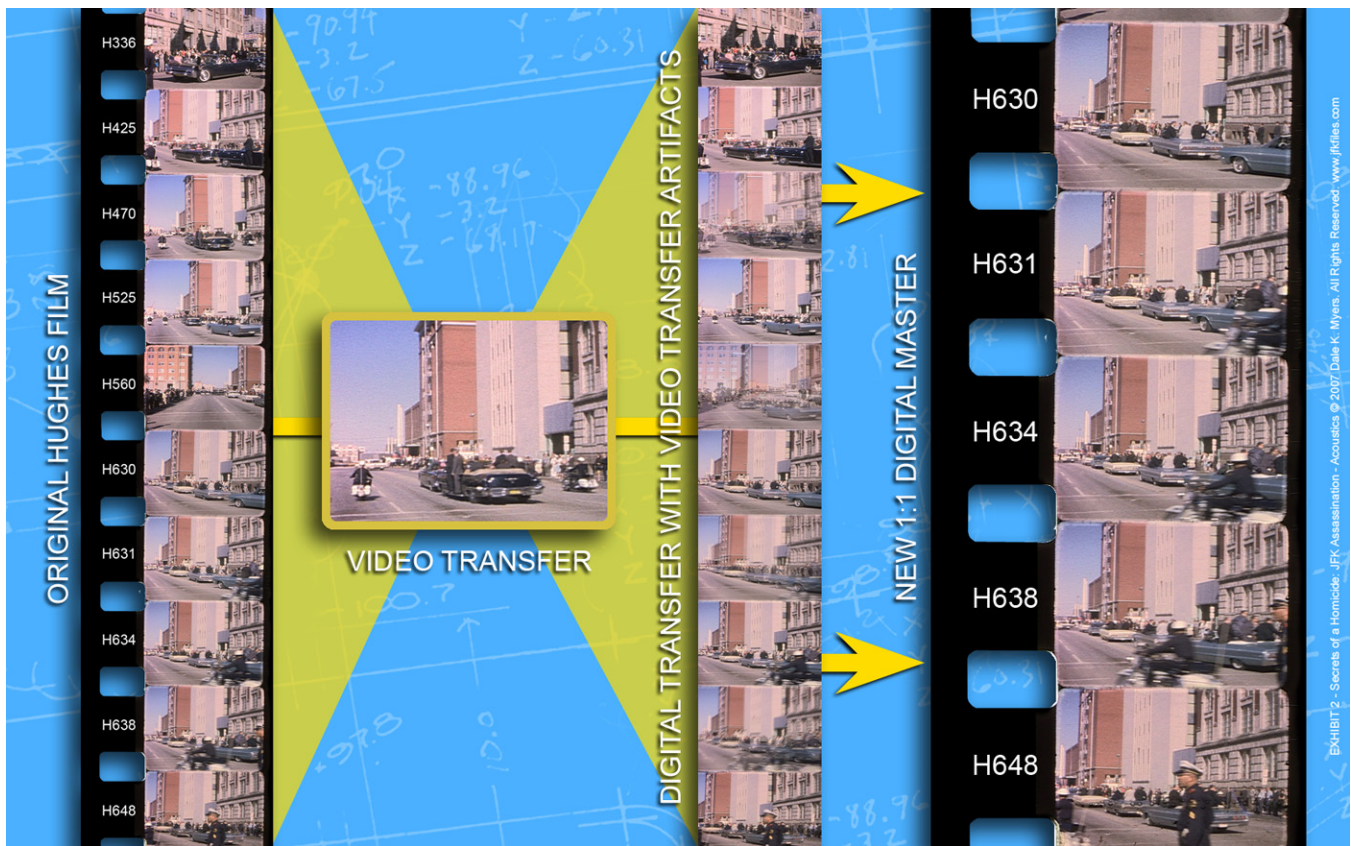


Exhibit 2. Process of converting video tape master recordings of amateur films to new 1:1 digital masters.

Two methods were used to determine those average frame rates:

- (1.) Visual reference
- (2.) Computer assisted geometric reference

The method of visual reference was as simple as comparing each frame of one amateur film with the frames of a second amateur film and looking for instances where the same action was depicted in both. Enlargements, stabilized sequences, and mosaic enhancements were created in software programs like Adobe *Photoshop* for analysis. Since several of the films under study (particularly Hughes, Dorman, and Towner) were created during the same time period, there were numerous points of reference which became the basis for achieving synchronization.

These visual reference points were aided and supported by geometric reference points established using a computer model of Dealey Plaza created for this project with NewTek's *LightWave 3D*. [Exhibit 3]



Exhibit 3. Computer model of Dealey Plaza based on survey maps, blueprints, photographs, and measurements.

The model was based on survey maps prepared for the City of Dallas and the 1978 House Select Committee on Assassinations. More than 500 personal photographs and measurements, gathered during multiple trips to Dallas, Texas, were utilized in the construction and placement of all fixed structures — including the Records, Criminal Court, and Dal-Tex Buildings. The model of the Texas School Book Depository was created from blueprints prepared for the 1978 restoration project. A multitude of contemporary photographs and films were studied in order to ensure that the model matched Dealey Plaza circa 1963. Contours of the surrounding earthscape were plotted using a grid of markers, which were physically placed in Dealey Plaza and photographed from multiple angles. These photographs were then imported into software which extracted three-dimensional data from the images to create a dimensional model of the landscape.

The position of each of the amateur photographers on November 22, 1963, was determined by placing a virtual camera into the computer model and matching the virtual camera's view of the computer model of Dealey Plaza with the actual view of Dealey Plaza as captured on film. [See, *Triangulation*, p.42, for a complete description.]

Once the photographers positions had been established, lines-of-sight were plotted between each virtual camera and fixed points in the computer model (i.e., corners of buildings, curb lines, window frames, etc.). These lines-of-sight became the basis for establishing geometric relationships between the individual photographers and their surroundings. By comparing the visual record (as captured on film) with the geometric relationship between the photographers and their surroundings, it was possible to establish:

- (1.) Numerous synchronization points between each of the amateur films, and
- (2.) The average frame rate of each camera, relative to Zapruder's camera.

The resulting synchronization of these amateur films establishes a single, continuous timeline which reveals the precise speed, path and position of each of the pertinent motorcade vehicles at the time the assassination shots were fired, including Officer H.B. McLain's motorcycle.

SYNCHRONIZING ZAPRUDER AND HUGHES

The key to answering the question of whether or not H.B. McLain could have reached the position predicted by the HSCA acoustic experts by the time of the first shot involves synchronizing the Hughes film (which depicts McLain on Houston Street) and the Zapruder film (which depicts the shooting sequence).

The Hughes film, which shows McLain completing his turn from Main onto Houston Streets, contains no direct visual information which enables the casual viewer to determine exactly when the assassination occurs since the president's limousine has already disappeared from view. ^[Exhibit 4]

Robert J.E. Hughes Jr., himself, wrote in a letter to his parents the night of the assassination that "...About five seconds after I quit taking pictures we heard the shots..." The exact number of shots Hughes heard was not reported.¹⁰⁴ Although some claim that the Hughes' letter is proof that the shooting began after he stopped filming, it is important to note that human recollection is often unreliable.¹⁰⁵

104. Thompson, Josiah, *Six Seconds in Dallas: A Micro-Study of the Kennedy Assassination*, Bernard Geis Associates, Random House, 1967, p.181 (Letter from Robert Hughes to his parents, Mr. and Mrs. Ray Hughes, November 22, 1963)

105. In a 2004 email, Gary Mack, originator of the acoustic evidence and one of its leading defenders, wrote: "[Hughes] could not possibly have been confused about when the shots sounded. Before, during or after would have been definitive points in time for him...He stopped filming and a few seconds later the shooting started. So any conclusion that McLain was too far back based on the Hughes film has to show some overwhelming evidence that the shooting started *while* Hughes was filming, and that evidence has to explain why he never noticed shots during filming and then heard three shots *after* filming." [Email message, Gary Mack to Michael O'Dell, March 9, 2004] Despite Mack's insistence that any evidence demonstrating that the shooting began before Hughes finished filming (as this project concludes) must somehow explain Hughes' failure to recollect the event in that manner, the overwhelming evidence presented in this document sufficiently demonstrates that Hughes' recollection was faulty regardless of the specific reason. It has been well-documented in other studies that ear witnesses to the assassination "heard" anywhere from 2 to 10 shots beginning at various times, despite the overwhelming physical evidence that only three shots were fired. It is not necessary to the conclusions of this paper to determine why Mr. Hughes recalled the sequence of events as he did.

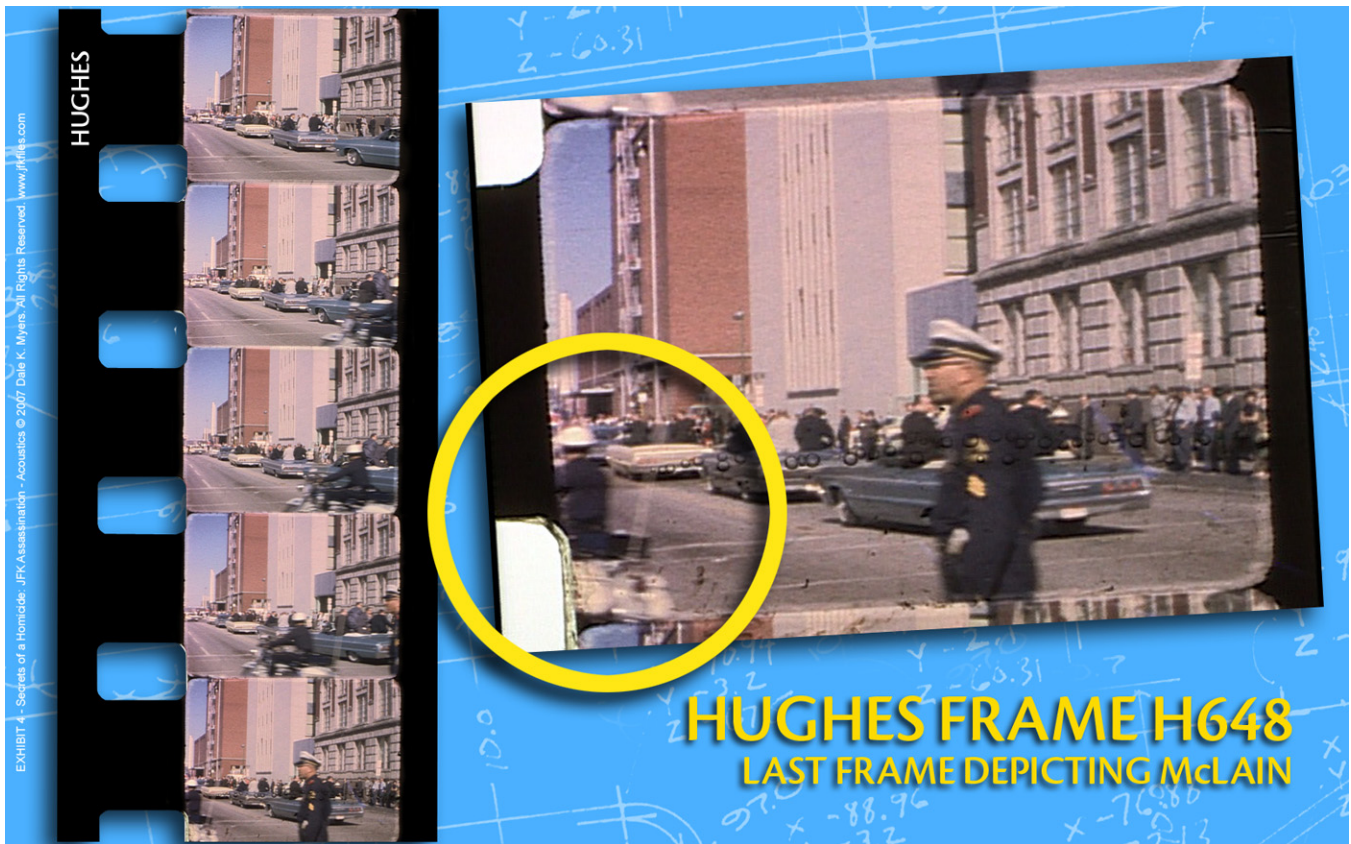


Exhibit 4. Hughes frame H648, the last depicting Officer H.B. McLain on Houston Street.

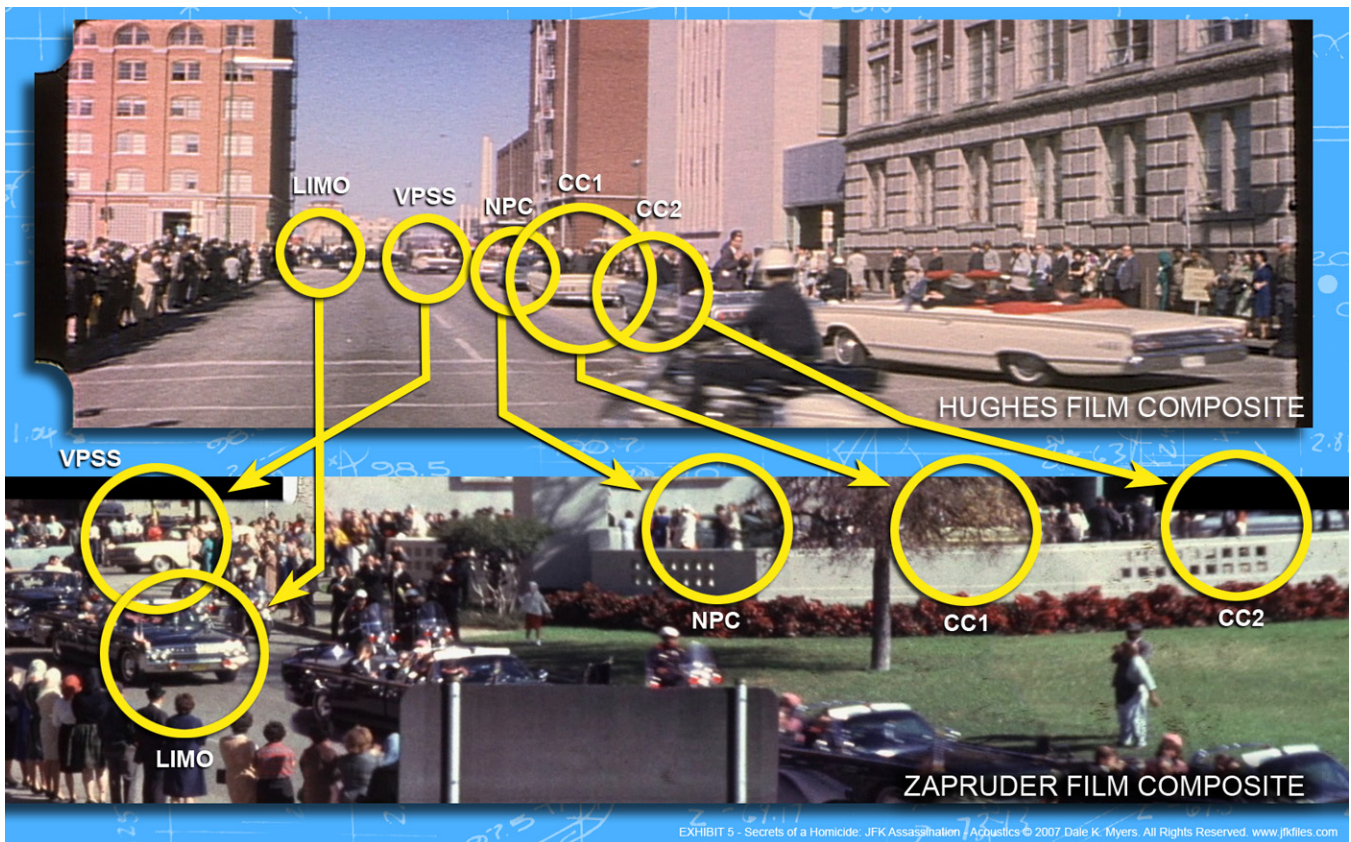


Exhibit 5. Various motorcade vehicles visible in both the Zapruder and Hughes films.

Although the presidential limousine is not visible during the latter moments of the sequences Hughes filmed on Houston Street – particularly the one that depicts H.B. McLain’s motorcycle – there are visual references that are common to both the Hughes film and the Zapruder film. For instance, the Hughes film not only captures the presidential limousine as it travels north on Houston but the seven motorcade vehicles and six motorcycle escorts that follow it.

The Zapruder film also captures the presidential limousine as well as a number of the same motorcade vehicles and motorcycle escorts that trail it. Several of these vehicles can be seen traveling north on Houston Street and making the turn onto Elm Street in the background of the film. ^[Exhibit 5]

Using these visual references and computer assisted geometric triangulation (i.e., the ability to pinpoint an object in space by triangulating its position based on two or more vantage points), it is possible to determine the relationship between the two films and, thus, synchronize them.

STABILIZATION TECHNIQUES

To assist in the synchronization process, the background of the Zapruder film was enlarged and stabilized using Adobe *Photoshop* software.

The stabilization process involved loading each frame of the film into *Photoshop*, finding an inanimate object within the field-of-view (i.e., a tree, a lamp post, the concrete wall, etc.) and making adjustments to each frame that would keep this object fixed, or stationary, as the sequence progressed. This method removes the jitter inherent in handheld motion picture photography. When these re-centered, stabilized film frames are recompiled and viewed as a motion sequence, new details previously obscured by the movements of the camera operator are revealed. ^[Exhibit 6]

In addition, adjacent pairs of select frames were processed to create stereoscopic images which allowed the study of spatial relationships between objects in Zapruder’s field-of-view. ^[Exhibit 7]

Of particular interest was the upper portion of the frame which, at the beginning of the film, depicts the intersection of Elm and Houston, and later, as Zapruder pans the camera to his right, the northern half of Houston Street which is visible above the concrete wall of the peristyle. It is this area that shows the motorcade vehicles trailing the president’s limousine.

The Hughes film was also enlarged and stabilized using the same techniques just described. Stereoscopic images were also created from adjacent frame pairs. Of particular interest was the background area depicting the intersection of Elm and Houston, and the progression of the motorcade vehicles, including H.B. McLain’s motorcycle, trailing the presidential limousine.

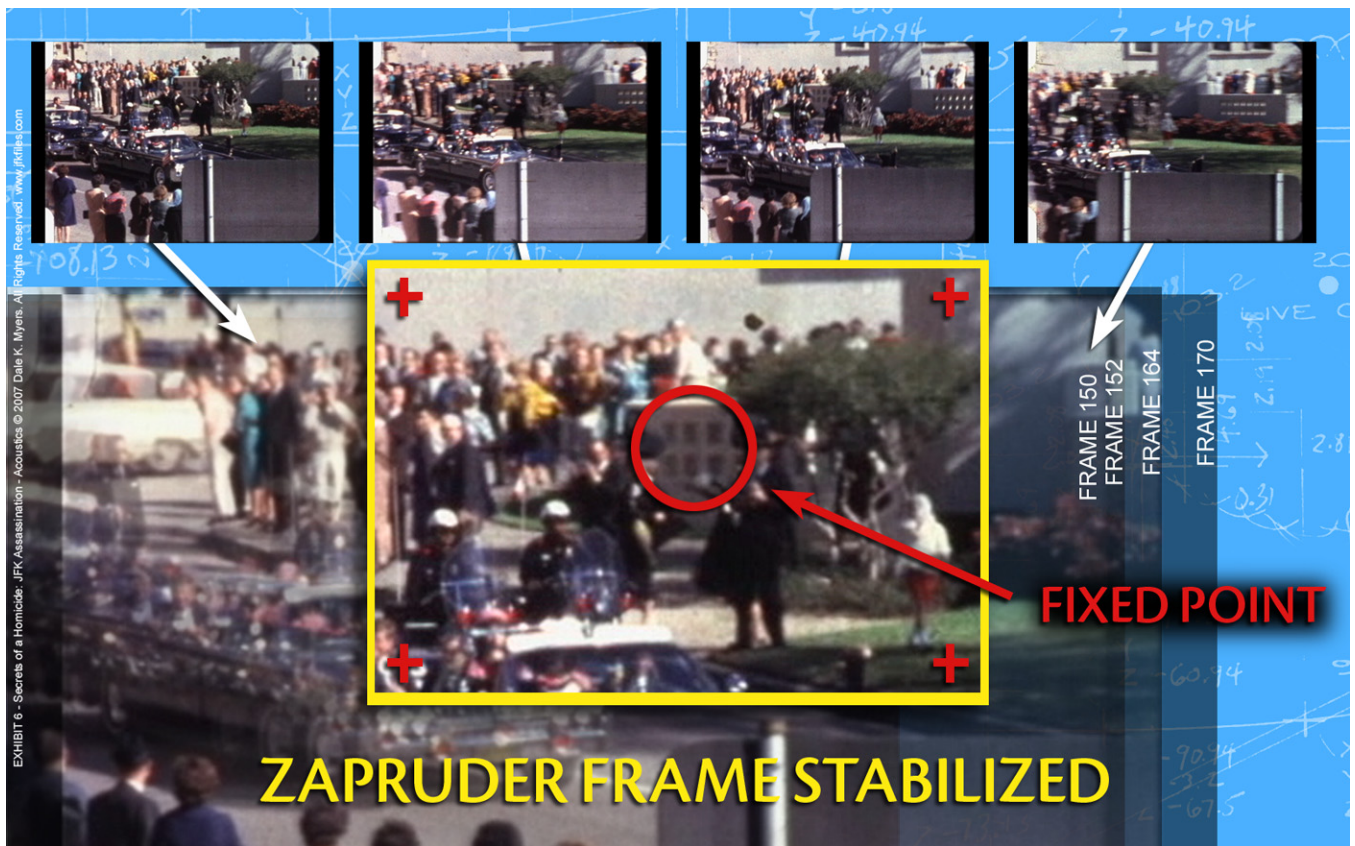


Exhibit 6. Process of stabilizing film footage by adjusting individual frames to fix an area of interest.



Exhibit 7. Process of creating stereoscopic images from adjacent film frames.

A comparison of the Zapruder and Hughes films reveals four vehicles, which are on-screen a sufficient period of time, upon which to base a synchronization of the two films. Those vehicles¹⁰⁶ are:

- **Secret Service Vice-Presidential follow-up Car.** The seventh car in the motorcade, a white 1963 Ford Mercury Monterey hardtop appears in both films making the turn from Houston onto Elm Streets.
- **National Press Pool Car.** The ninth car in the motorcade, a blue/grey 1960 Chevrolet Bel Air hardtop appears in both films traveling north on Houston Street.
- **Camera Car 1.** The tenth car in the motorcade, an off-white 1964 Chevrolet Impala convertible appears in both films traveling north on Houston Street.
- **Camera Car 2.** The eleventh car in the motorcade, a blue/grey 1964 Chevrolet Impala convertible appears in both films traveling north on Houston Street.

SYNCHRONIZATION PROCESS

The synchronization of the two films involved three basic steps:

- 1 Determine the speed of each vehicle based on the Zapruder film's average frame rate.
- 2 Use the known speed of each vehicle to determine the average frame rate of the Hughes film relative to Zapruder's camera.
- 3 Use the average frame rates and computer-assisted geometric triangulation to plot the relationship between the two films.

106. The description and position of each car in the motorcade described above and throughout this document references the *Presidential Motorcade Schematic Listing, November 22, 1963, Dallas, Texas*, prepared by Todd Wayne Vaughan in 1992.

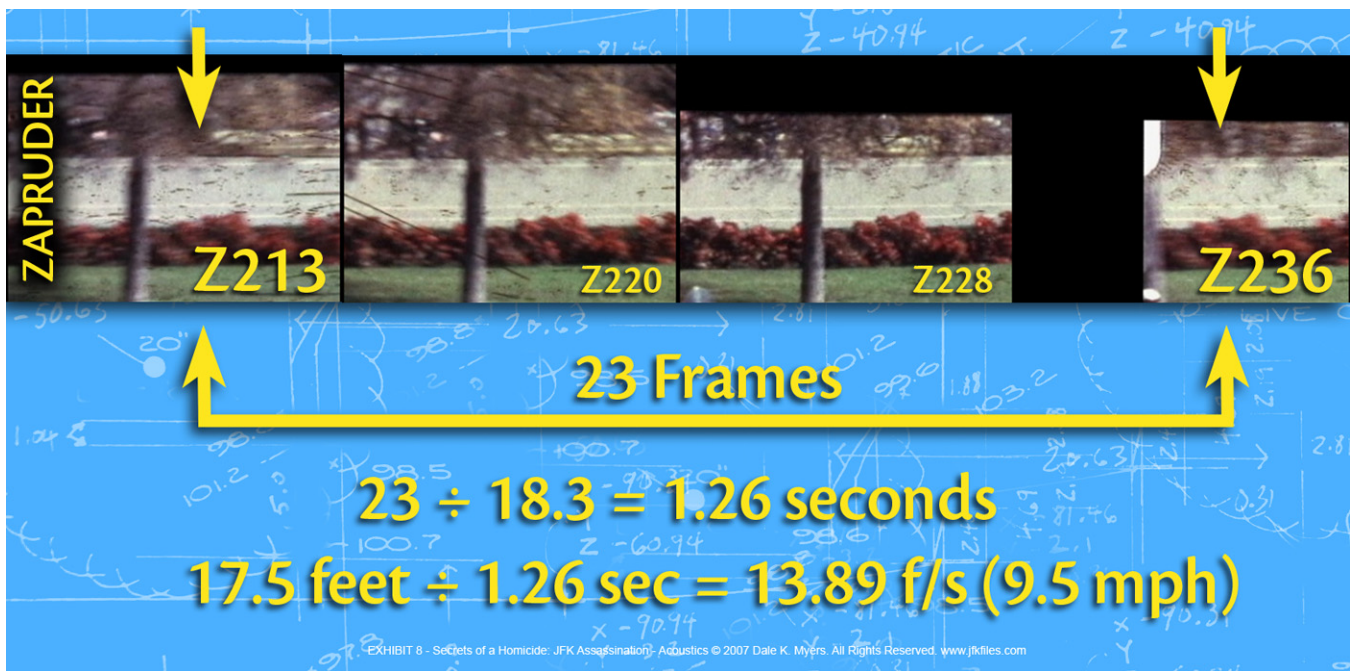


Exhibit 8. Calculating the average speed of Camera Car 1.

Determining Vehicle Speed

Determining the speed of each vehicle was relatively straight forward. Portions of the Zapruder film were enlarged, stabilized and examined; the number of frames it took a vehicle of known length to pass a fixed point were counted; and a simple formula applied.

For example, a stabilized portion of the Zapruder film (Z213-236) depicts Camera Car 1 passing through Zapruder's field-of-view. Camera Car 1 was a 1964 Chevrolet Impala with a wheelbase of 9.9 feet and an overall length of 17.5 feet.¹⁰⁷

A frame count shows that it took 23 Zapruder frames for Camera Car 1 to traverse a distance equal to its own length (i.e. 17.5 feet). Dividing those 23 frames by 18.3 (the average speed of Zapruder's camera) yields a time of 1.26 seconds for Camera Car 1 to travel its own length. That computes to a speed of 13.89 feet-per-second (or 9.5 mph). [Exhibit 8]

The speed of each of the cars visible in the background of the Zapruder film was calculated in the same manner. Slight variations in speed were noted (i.e., Camera Car 1 was moving at 9.5 mph; Camera Car 2 was moving at 9.1 mph; etc.) as would be expected in a procession of this kind.

107. Gunnell, John, *Standard Catalog of American Cars: 1946-1975, Revised 4th Edition*, Krause Publications, 2002, p.182

Determining the Frame Rate of the Hughes Camera

Determining the operating speed of the Hughes camera was now a simple matter of counting the number of frames it takes for the same vehicle to pass a fixed point in the Hughes film, applying the known speed of the vehicle to the equation, and computing the frame rate of the camera. [Exhibit 9]

The answer shows that that Hughes camera was for all practical purposes operating at the same average frame rate as Zapruder's camera (i.e., 18.3 frames per second). This fact can be confirmed by analyzing the speed of all of the vehicles common to both films. In all cases the answer is the same.¹⁰⁸

The operating speed of each amateur camera used in this analysis was calculated in the same manner – i.e., finding elements common to two of the films, determining the known operating speed of at least one of the cameras by relating it to the known speed of the Zapruder film, and using that information to determine the unknown operating speed, relative to Zapruder's camera, of the remaining camera.

The geometric triangulation techniques described earlier and the computed operating speed of the cameras provided a way to plot the relationship between all nine amateur films.

Plotting the Relationship of the Zapruder & Hughes Films

In the case of the Hughes film, there are six different independent reference points upon which to base a synchronization of the Hughes and Zapruder films. All six independent reference points demonstrate that the two films synchronize in the same manner, as would be expected. In short, each method of synchronization is confirmed and validated by the other five independent methods of synchronization.

108. In a 2004 email, Gary Mack, the originator of the acoustic evidence and one of its leading defenders, claimed that because the Hughes camera (which is no longer in existence) was never tested "its running speed is unknown and unknowable." Mack wrote that FBI tests of the Zapruder and Nix cameras showed different speeds throughout the film with a variation "on the order of 10% or more." Mack noted that a speed variation of 10% over 30-seconds amounted to a discrepancy of 3 full seconds. Mack concluded that "any analysis using the Hughes film to 'prove' McLain was going to slow, or just fast enough, is misleading at best." (Email message, Gary Mack to Michael O'Dell, March 9, 2004) All three of Mack's claims are false. First, the average speed of the Hughes camera *relative to the Zapruder camera* is "knowable" because the Zapruder camera was tested by the FBI, as Mack himself acknowledges. The accuracy of that relative speed is validated by the visual information contained in the film itself as it relates to other films which were synchronized to the Zapruder film using the same methods. Two, the Zapruder camera's speed varied by a maximum of 3%, not by ten percent as Mack reported. The Nix camera's speed also varied by 3%; although the FBI lab did report that the frame rate dropped to 15.75 fps during the final five seconds of runtime (a variation of 12.5% from the standard 18 fps setting). However, in calculating the average speed of the Nix camera (determined to be 18.5 frames-per-second), the FBI *excluded* the last five seconds of runtime "since the pertinent portions of Mr. Nix's assassination film were exposed prior to the last five seconds." Third, Mack's claim that a 10% variation in camera speed over 30-seconds would amount to a discrepancy of 3 full seconds *assumes* that the Zapruder camera would maintain a 10% acceleration over a 30 second period. This is demonstratively *false*. In fact, the FBI lab reported that when fully wound the Zapruder camera's speed increased by only 0.5% during the first ten seconds, increased an additional 1.0 to 2.0 % during the next 20 seconds, decreased 1.0 to 2.0 % for ten seconds, and decreased an additional 1.0 to 2.5 over the final 20 seconds. (FBI Lab Report, December 20, 1963) The maximum speed of the Zapruder camera was therefore only 1.5 to 2.5 % faster than the factory set speed of 18 frames-per-second. This variation would only amount to between 8 and 13.5 frames over 30-seconds; a discrepancy of just 0.44 to 0.75 seconds, *not* 3 full seconds as Mack claimed.

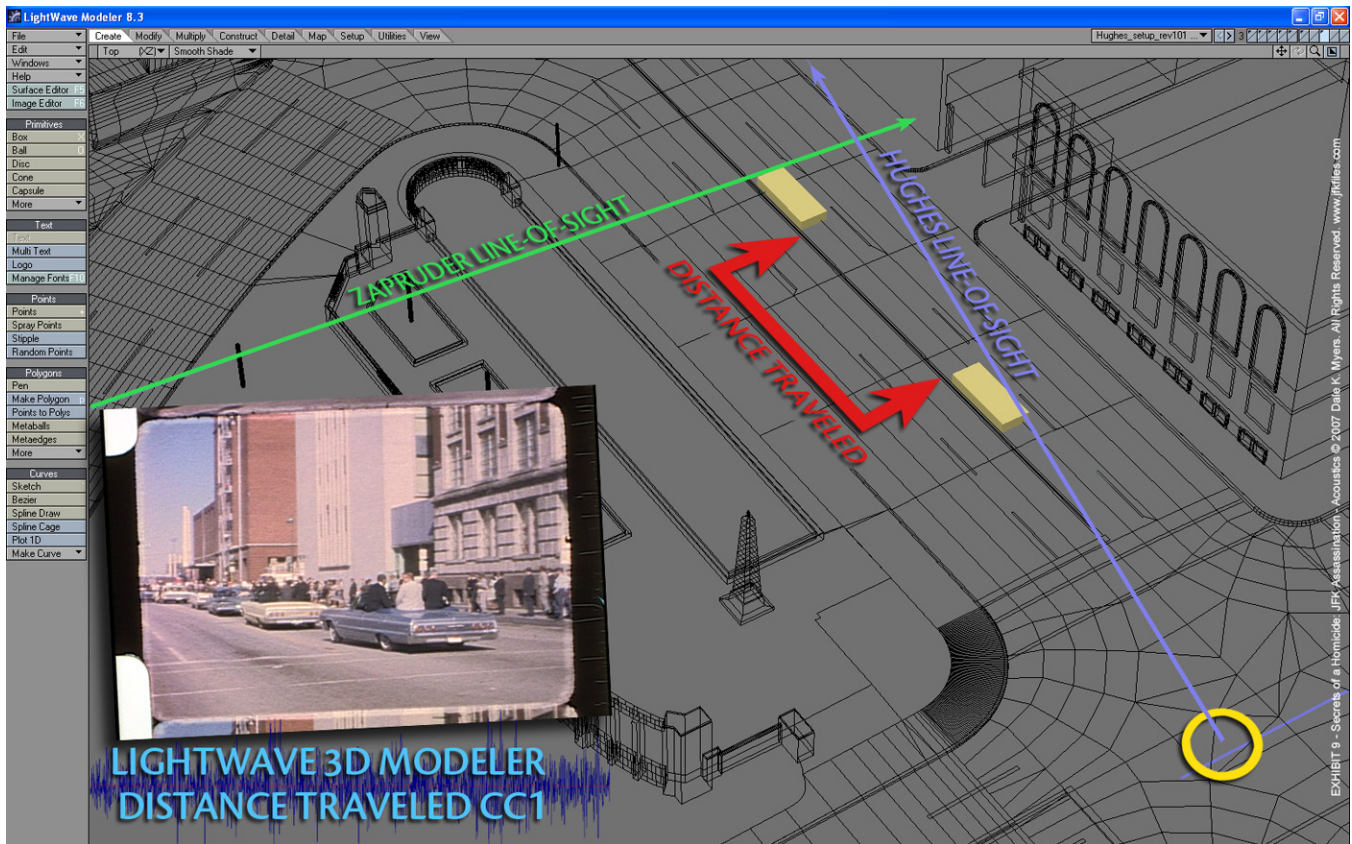


Exhibit 9. Using a computer model to determine the distance traveled between two known locations.

One of those common reference points appears in the background of the Zapruder film just as the President's car begins to glide down Elm Street. That reference point is the seventh car of the motorcade – the Secret Service Vice-Presidential Follow-up Car – a white 1963 Ford Mercury Monterey hardtop making the turn from Houston onto Elm Street. [Exhibit 10]

This same car is also visible in the Hughes film at about the same time. [Exhibit 11] Because this vehicle appears in both films at about the same moment in time, it is possible to synchronize the two films using this vehicle as a reference point. One method of synchronizing the two films was to use the angle of the Secret Service follow-up car as it moved along the arc of its turn.

The angle of the Secret Service car as seen in the Hughes film was determined by aligning the film with a computer model of Dealey Plaza using a method known as *triangulation*.



Exhibit 10. The Secret Service Vice-Presidential Follow-Up car as it appears in the Zapruder film.

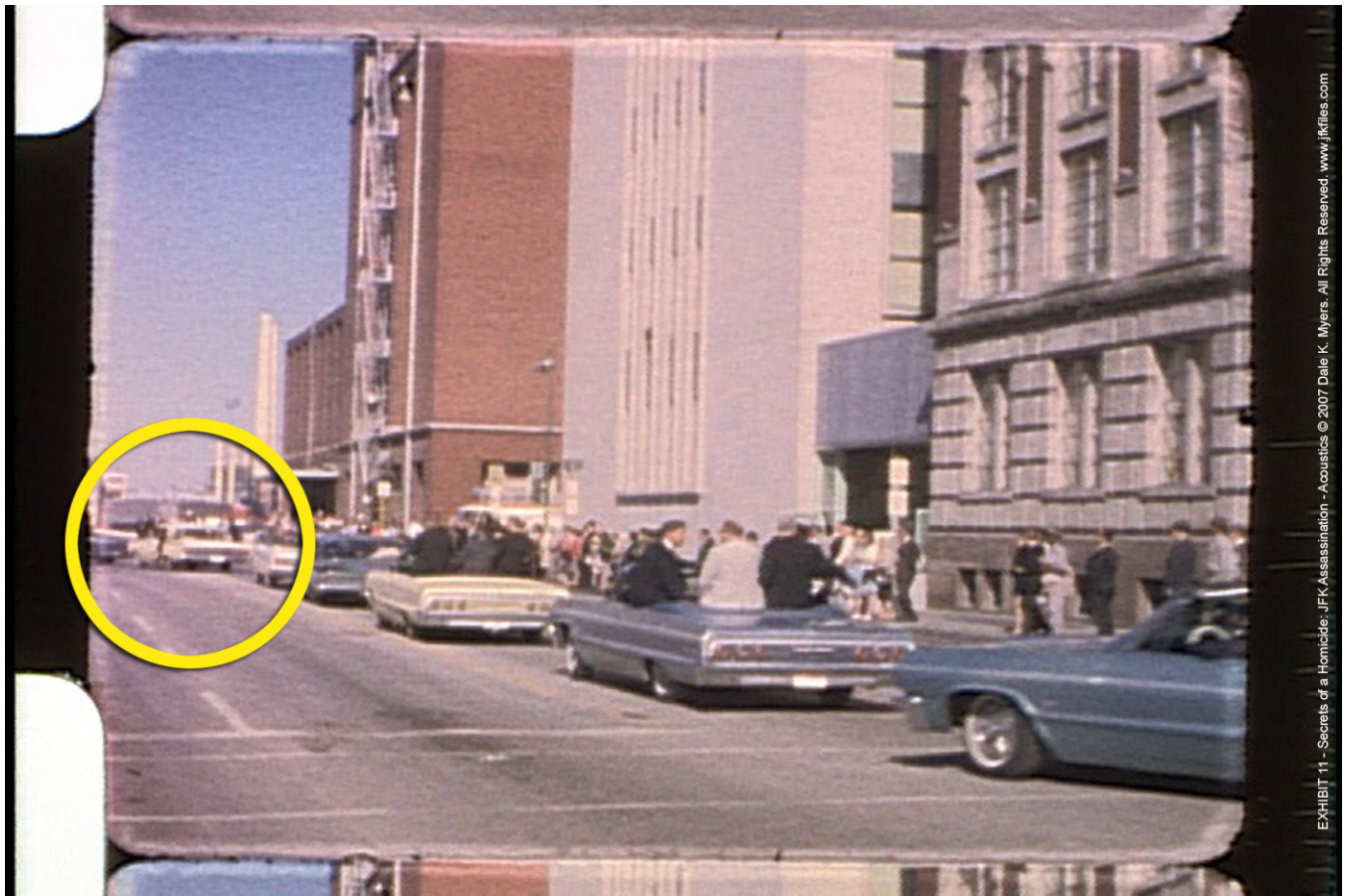


Exhibit 11. The Secret Service Vice-Presidential Follow-Up car as it appears in the Hughes film.

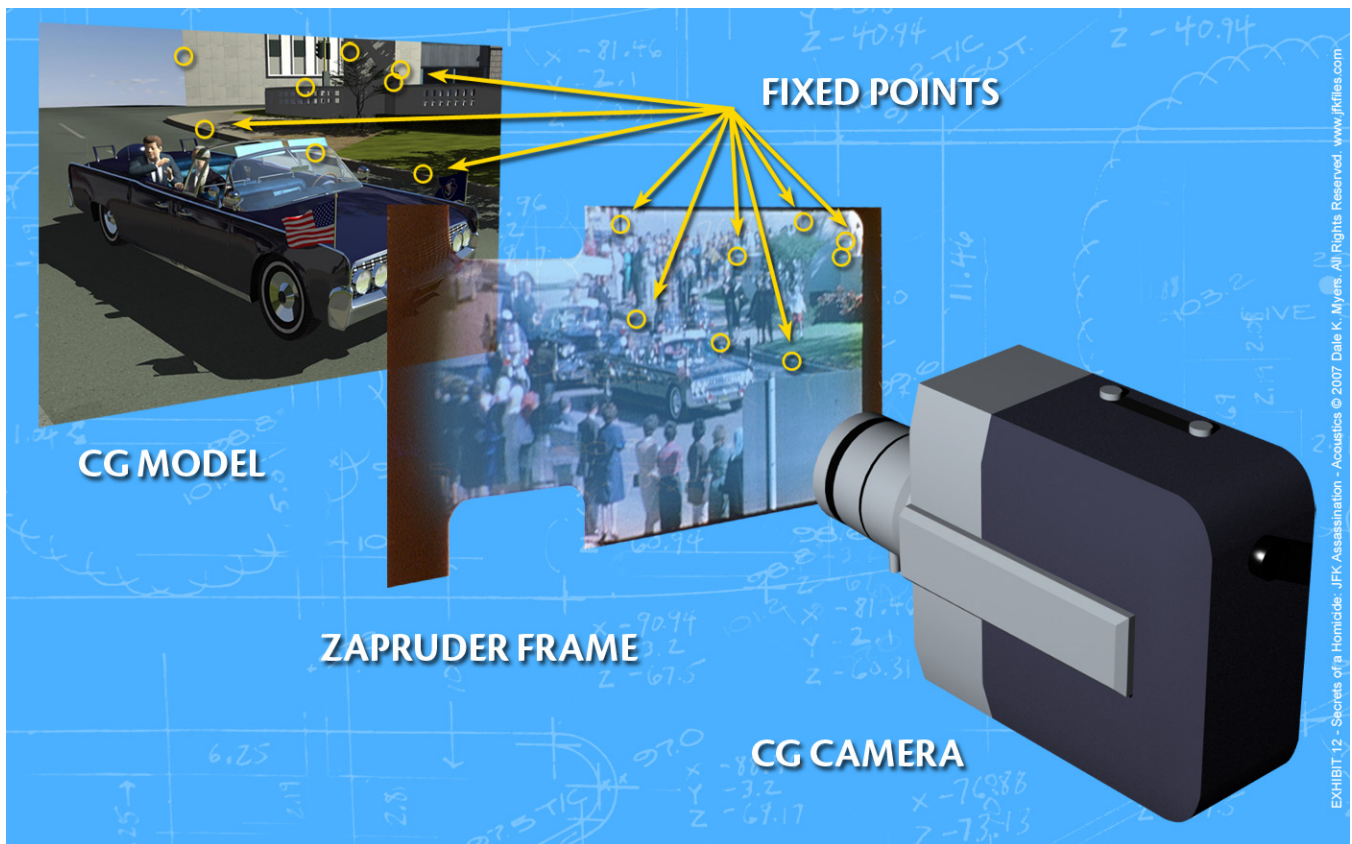


Exhibit 12. Process of matching computer models to film footage using triangulation to position the camera.

Triangulation

Triangulation is a highly accurate way of computing the six degrees of a camera's freedom based on camera footage. This technique is based on epipolar geometry¹⁰⁹ and is used by many of the world's foremost motion picture visual effects masters to seamlessly match computer generated imagery with live action footage.

Through triangulation, it is possible to determine a camera's position in 3D space by taking any film or video footage that a camera has recorded; superimposing that footage over a three-dimensional model of the scene recorded; and triangulating three or more fixed points that are visible within its field of view. [Exhibit 12] Because the technique applies to any motion picture footage, historic events can be explored using this method.

It's a tedious process that involves advancing the footage one frame at a time; aligning three or more fixed points in the footage to the same points on the model by adjusting the virtual

109. Epipolar geometry describes the geometric relationship between two optical systems viewing the same subject and can be used to locate points or objects in space. Because a moving camera offers a new view every frame, epipolar geometry works for a single moving camera as well, and each new view is understood as a separate optical system.

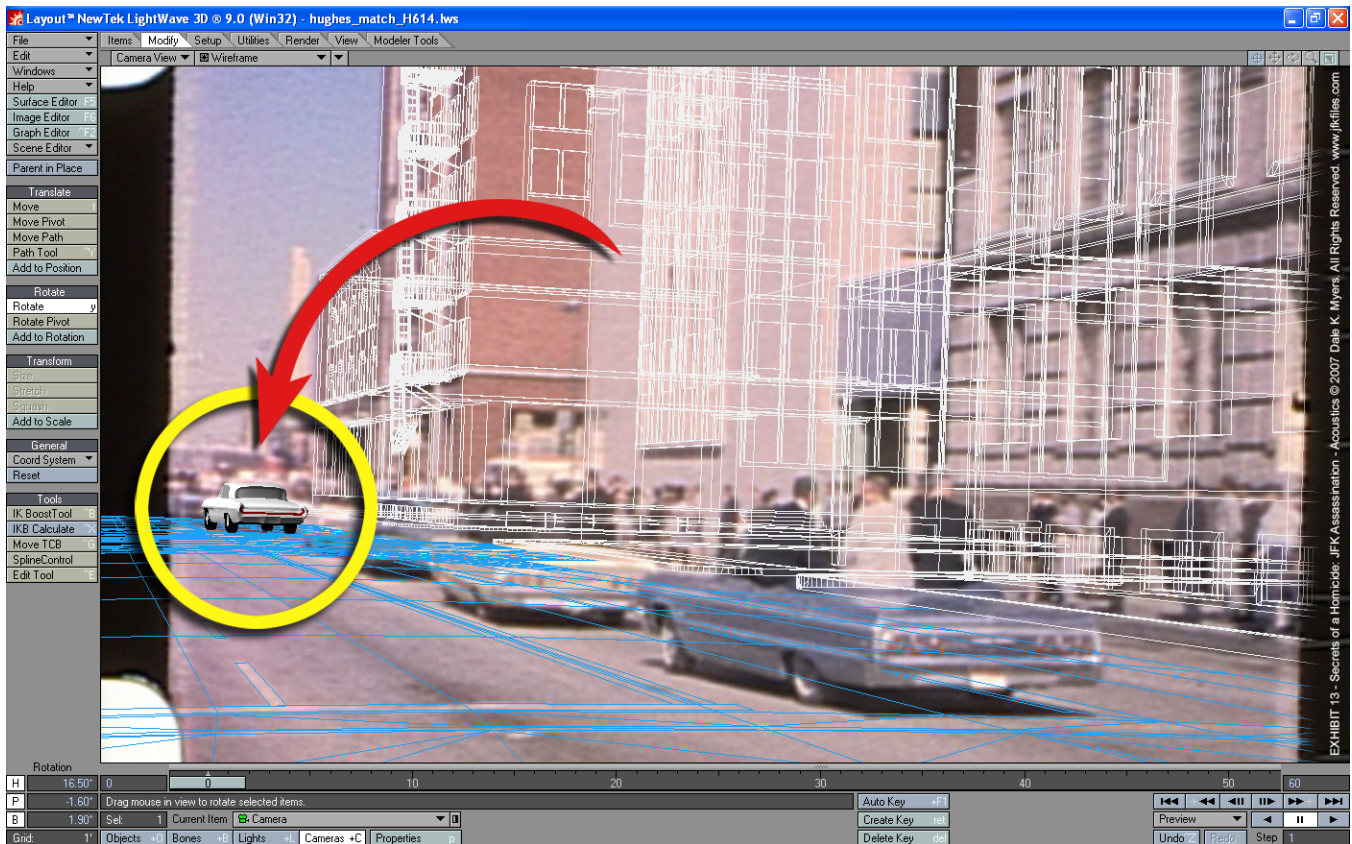


Exhibit 13. Geometric match of computer model to Hughes frame H614.

camera's six-degrees of freedom (i.e., moving and/or rotating the virtual camera); locking the camera's position using key frames;¹¹⁰ then advancing the footage to the next frame and repeating the process.¹¹¹

Newtek's *LightWave* software made it possible to look through the lens of the virtual camera that had been positioned to replicate the Hughes camera and see each frame of the Hughes film superimposed over this view. In other words, it was possible to look through each frame of the film (as if looking through a slide or transparency) and see the computer model beyond it.

Using the triangulation techniques just described, the fixed portions of the computer model that were visible in the virtual camera's field-of-view were aligned with the real-world counterparts of those fixed objects as seen in the Hughes camera's field-of-view, frame-by-frame. The result was an animated view of the computer model of Dealey Plaza that moved in frame-for-frame synchronization with the Hughes film.

110. Key framing is a term used in computer animation and refers to the ability to record the positions of multiple objects at any given moment in time.

111. This manual process has been largely replaced in the last few years by camera match-moving software like RealViz's *MatchMover*, 2D3's *Boujou*, SynaPix's *SynaMatch*, and Autonomous Effect's *CameraGenie*.

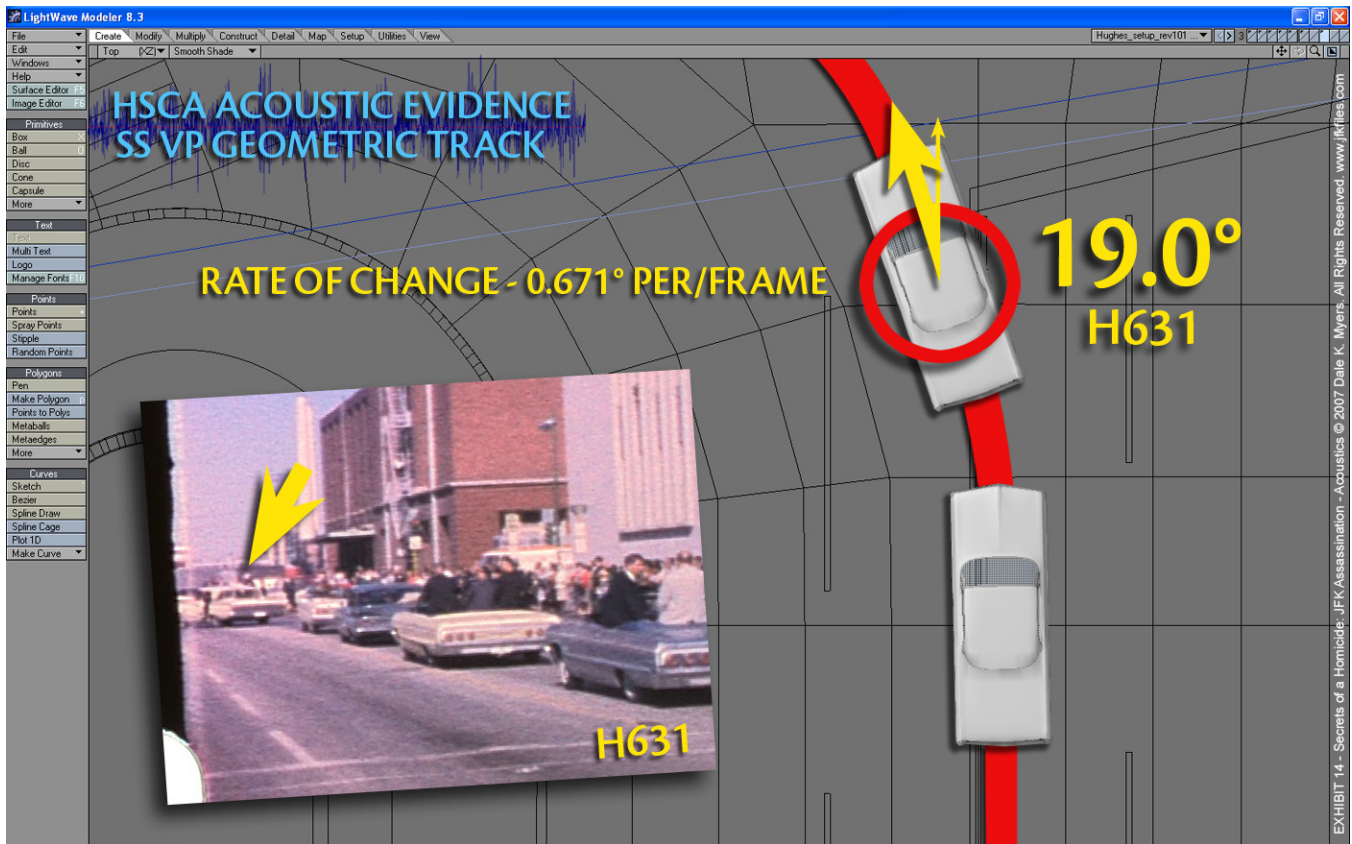


Exhibit 14. Position of Secret Service Vice-Presidential Follow-Up Car at Hughes frame H631.

Determining the Angle of the Secret Service car

Once the Hughes film was aligned to the model, a computer model of the 1963 Mercury was loaded and rotated it until it matched the angle of its real-world counterpart at Hughes frame H614. [Exhibit 13] The vehicle's movements were then tracked frame-by-frame until it disappeared into the margin of the film; the angle of the car relative to Houston Street recorded at each frame. The last recordable angle (i.e., the last frame in which at least three points of reference were available to reliably deduce an angle) was 19-degrees at Hughes frame H631; with the average rate of change determined to be approximately seven-tenths of a degree per frame, or, 12.3 degrees of change per second. [Exhibit 14]

Next, the Zapruder film was loaded. Once again, a virtual camera was created to represent the Zapruder camera. The six degrees of freedom of this virtual camera was then matched to the Zapruder film using the triangulation technique previously described. Next, a model of the 1963 Mercury was loaded and rotated until the angle matched that shown in the film. [Exhibit 15]

The first angle obtained was taken from Zapruder frame 150, when the front of the Secret Service car emerges from behind the crowd gathered at the corner of Elm & Houston Streets.

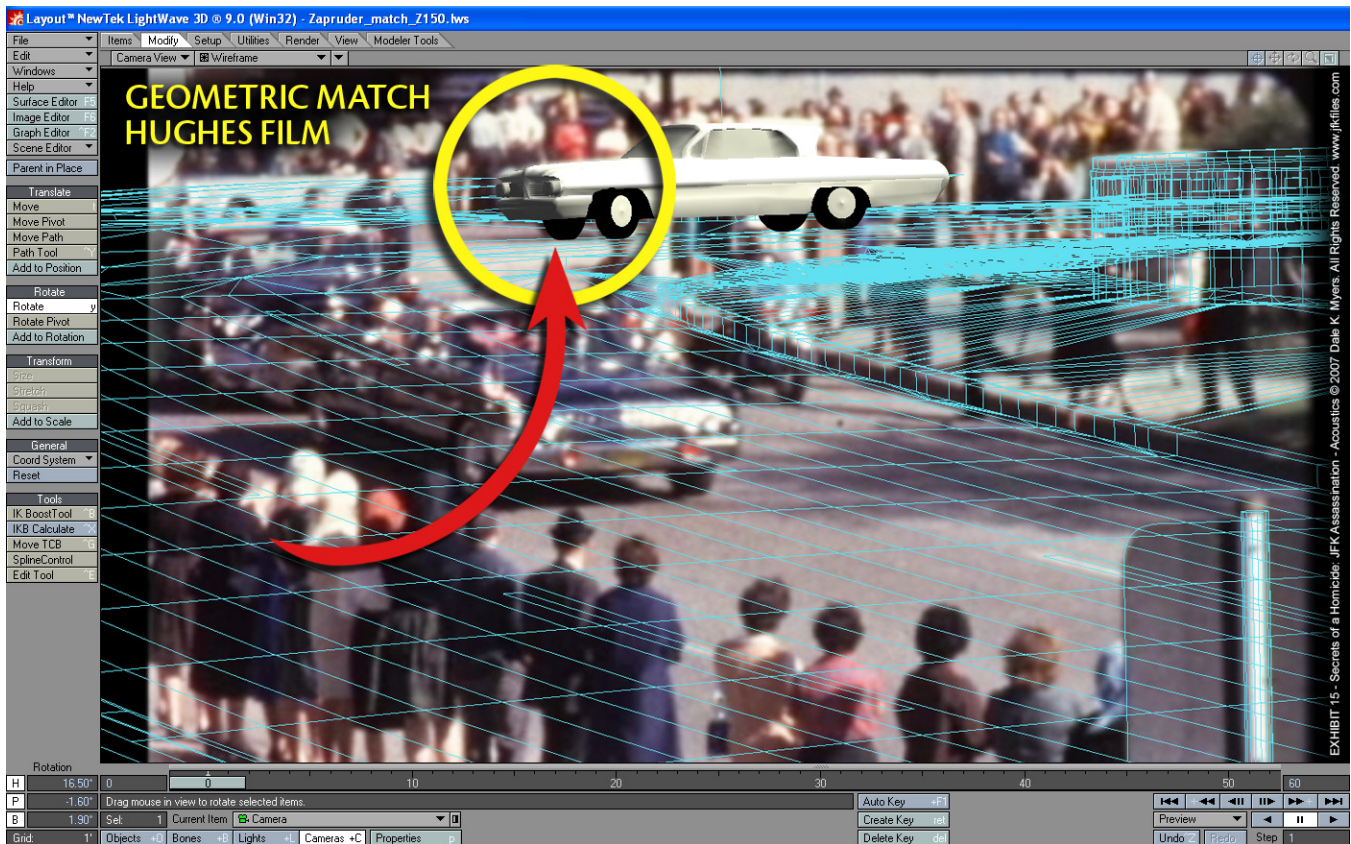


Exhibit 15. Position of Secret Service Vice-Presidential Follow-Up Car at Zapruder frame Z150.

The angle at that point was 33.5-degrees with the average rate of change over the next 26 frames found to be a little less than one degree per frame, or, 17.0 degrees of change per second. [Exhibit 16]

The data so far shows a last known angle of 19 degrees, culled from the Hughes film, and a first known angle of 33.5 degrees acquired from the Zapruder film. The question is: How much time elapsed between those two known angles? In other words, how long did it take for the angle of the Secret Service car to increase from 19 degrees to 33.5 degrees as it traveled along the arc of its turning radius? [Exhibit 17]

The two slight variations in the average rate of change of that angle – 12.3 degrees/second (culled from the Hughes film) and 17.0 degrees/second (culled from the Zapruder film) – is strong evidence that the turning radius of the car had changed slightly during the interval between the two sequences.¹¹² Consequently, the best that can be hoped for using this method is a *range of synchronization* between the Hughes and Zapruder films.

112. The difference between the two rates of change is probably attributable to a slight change in the turning radius as the driver of the vehicle navigated the 120-degree turn from Houston onto Elm Street. For instance, a 0.28 degree change per frame in the turning radius of the Secret Service car during the one second interval between Hughes frame H631 and H648 would account for the difference in the angle of the vehicle between the two films.

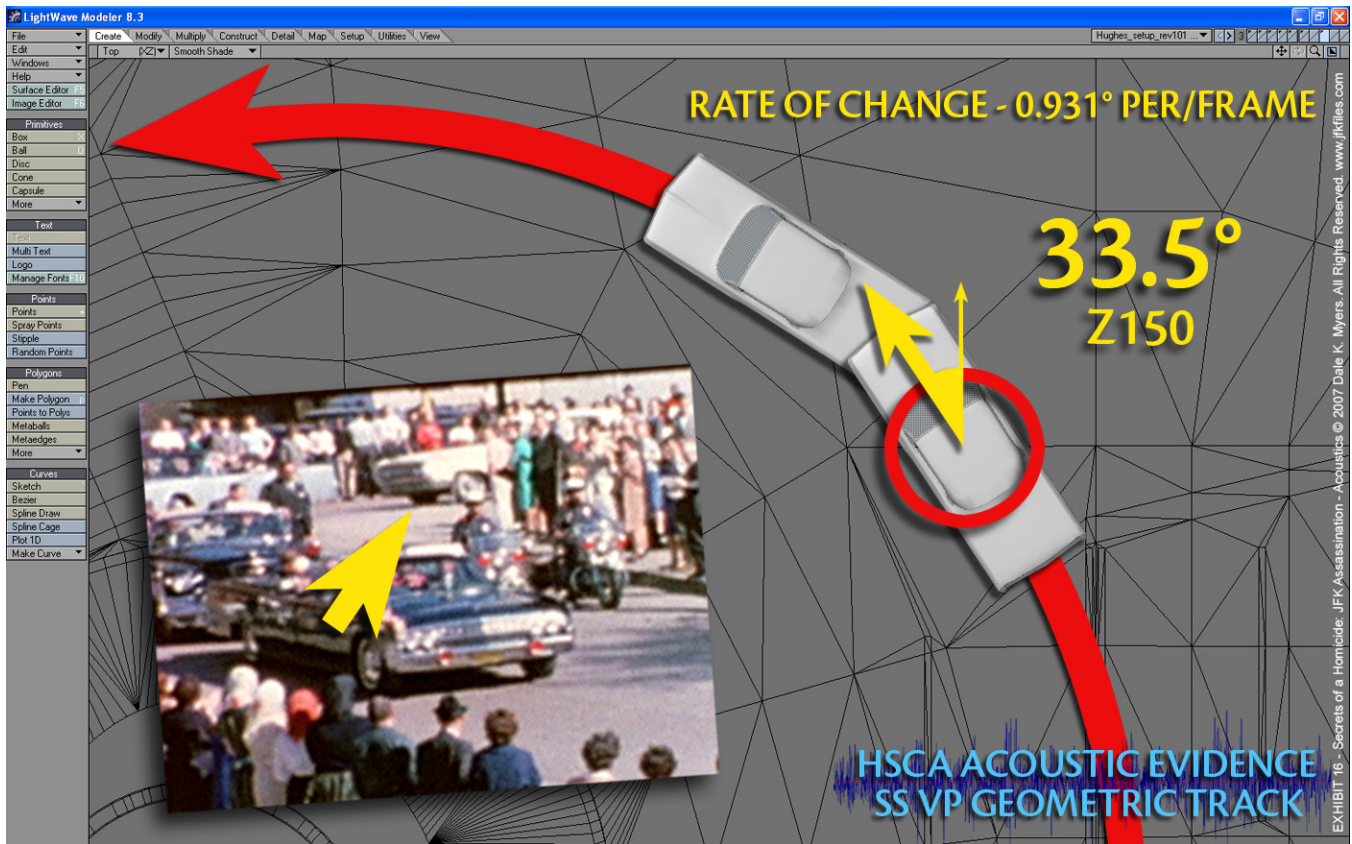


Exhibit 16. Angle of Secret Service Vice-Presidential Follow-Up Car at Zapruder frame Z150.

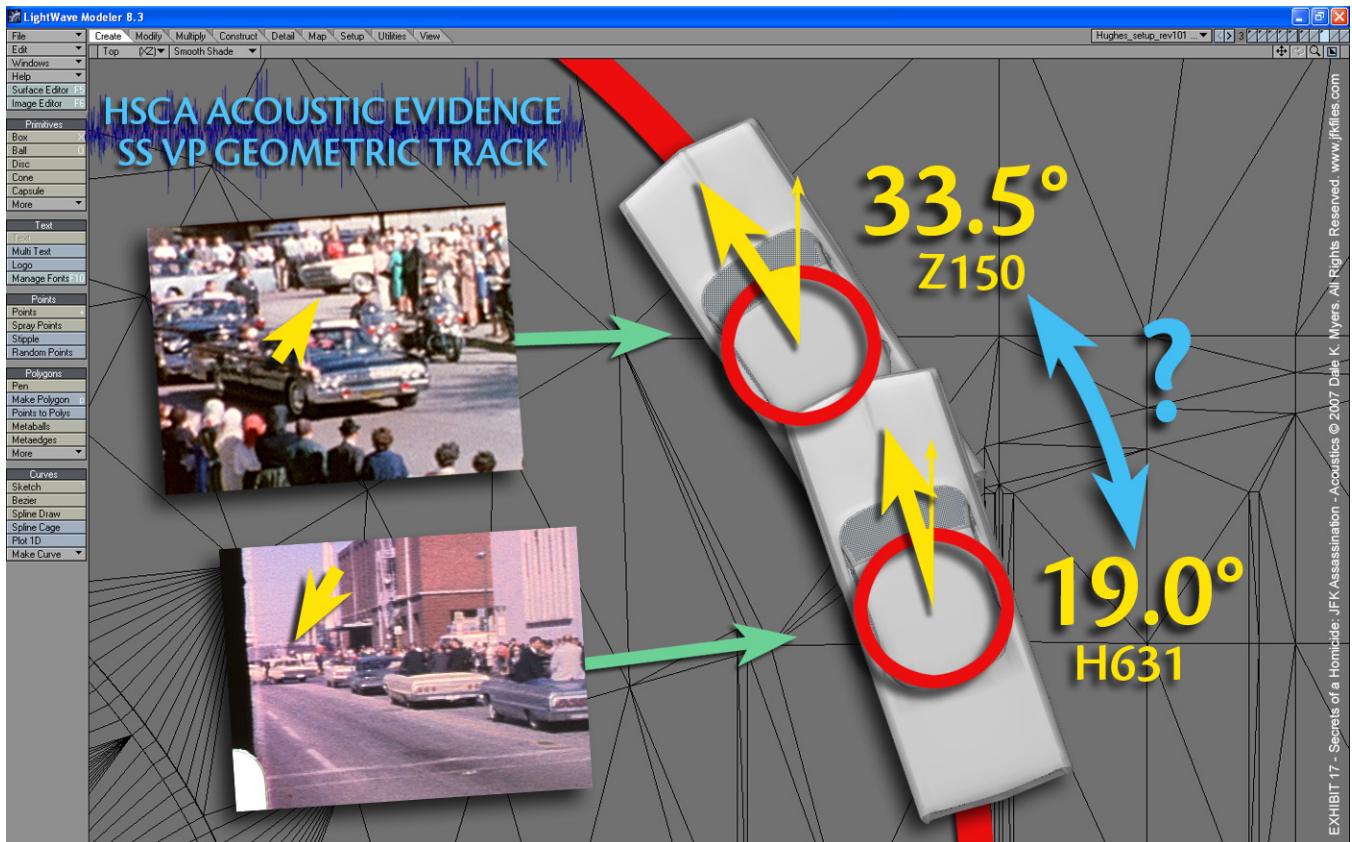


Exhibit 17. Difference in angle of Secret Service Vice-Presidential Follow-Up Car at H631 and Z150.

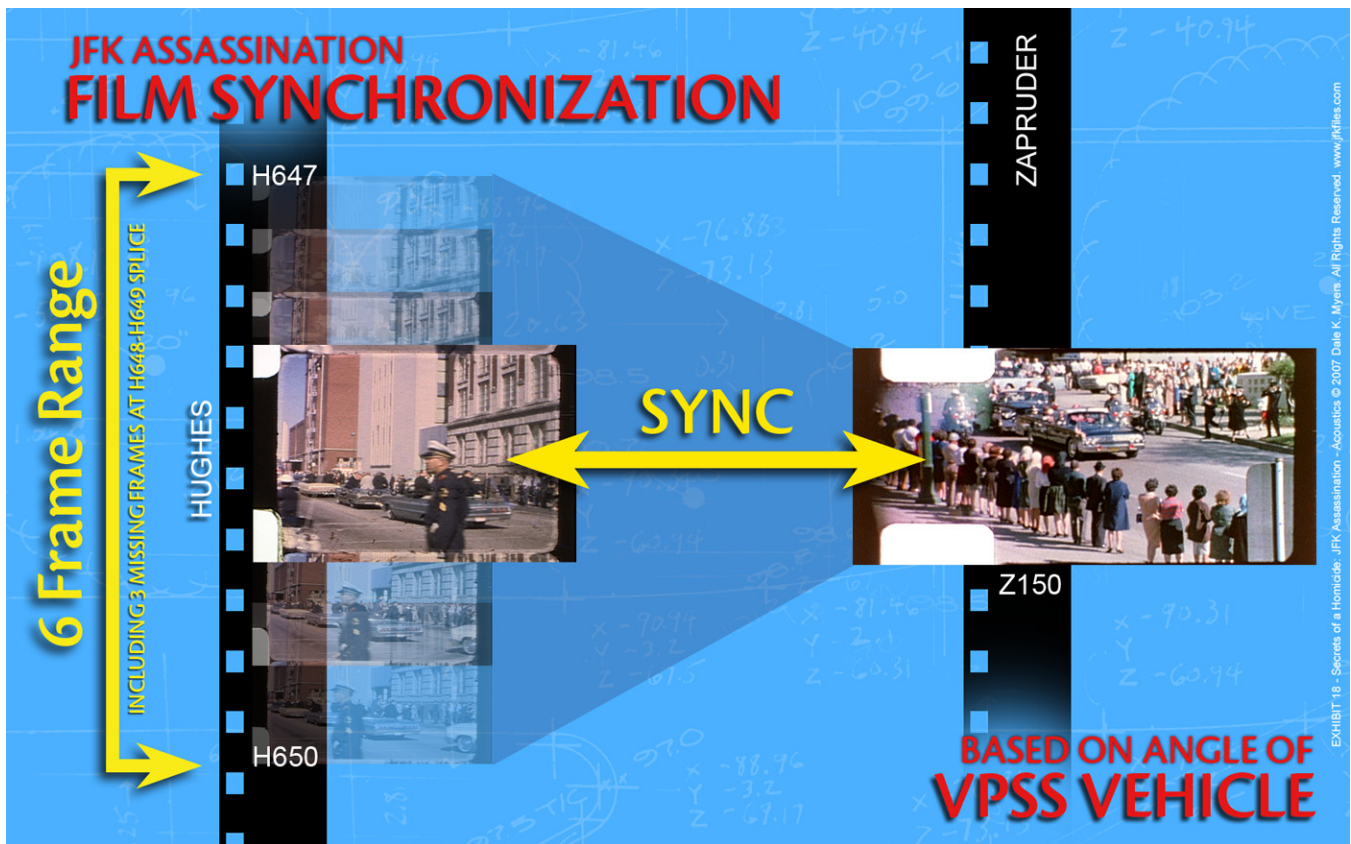


Exhibit 18. Six frame range of synchronization between Hughes and Zapruder films using angle of VPSS car.

That range is somewhere between 16 and 22 frames. In other words, 16 to 22 Hughes/Zapruder frames¹¹³ elapsed between the events depicted in Hughes frame H631 and Zapruder frame Z150. Expressed another way, Zapruder frame Z150 synchronizes to the Hughes film somewhere in the range of Hughes frames H647 to H650¹¹⁴ using this method. [Exhibit 18]

There is, however, a way of narrowing this six-frame-range of synchronization to a single frame using the *speed* of the Secret Service car rather than its angle to determine how much time elapsed between Hughes frame H631 and Zapruder frame Z150.

Determining the Speed of the Secret Service car

This is a relatively straight forward process whereby an average speed is calculated based upon two known speeds which is then applied to a known distance between two points to determine the unknown time period required to traverse that distance.

113. For all practical purposes, the Zapruder and Hughes cameras were found to be operating at the same speed – 18.3 frames/second.

114. A splice exists between Hughes frames H648 and H649, wherein three frames are missing. These three frames are included in the six frame interval between H647 and H650.

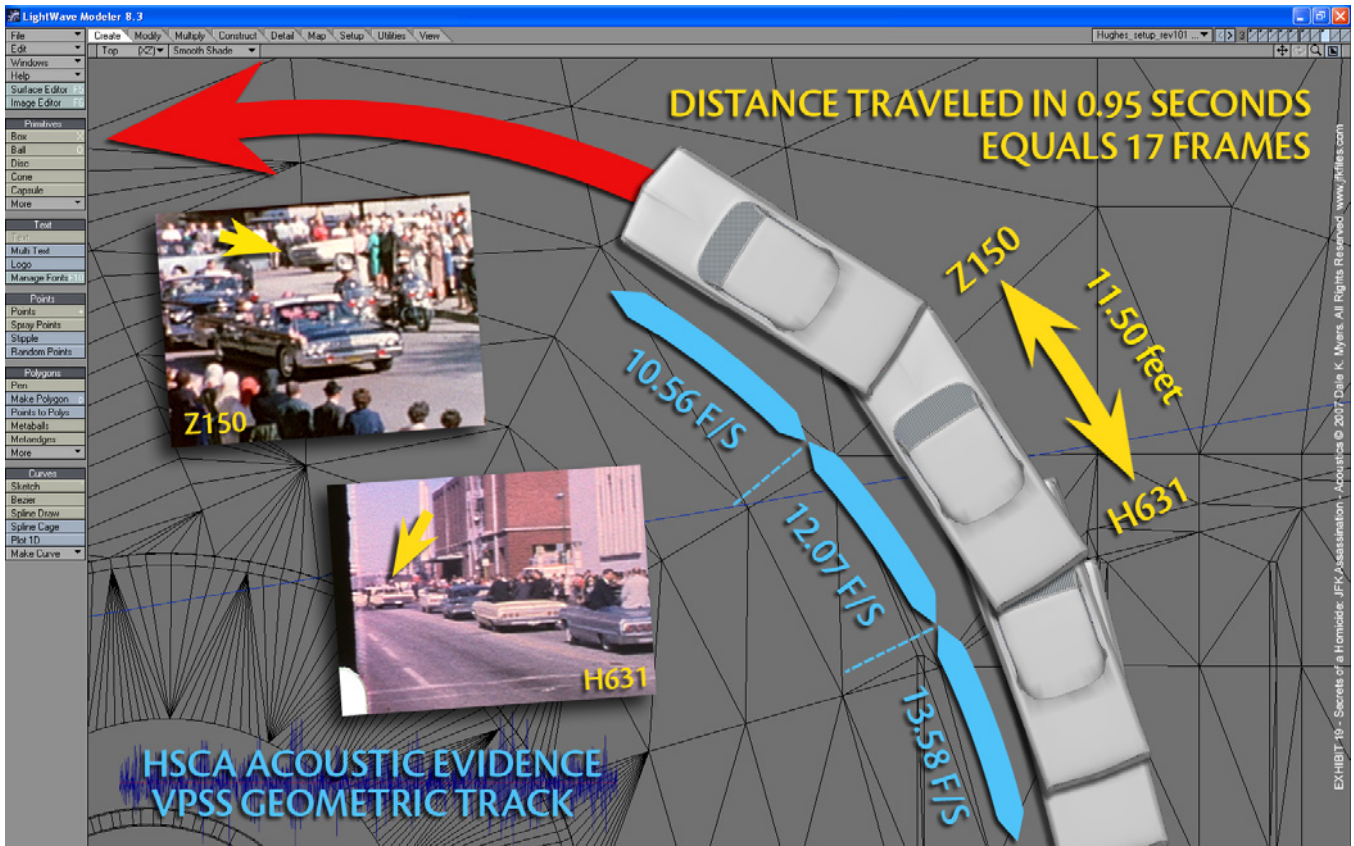


Exhibit 19. Distance traveled by the VPSS car in 0.95 seconds between Hughes H631 and Zapruder Z150.

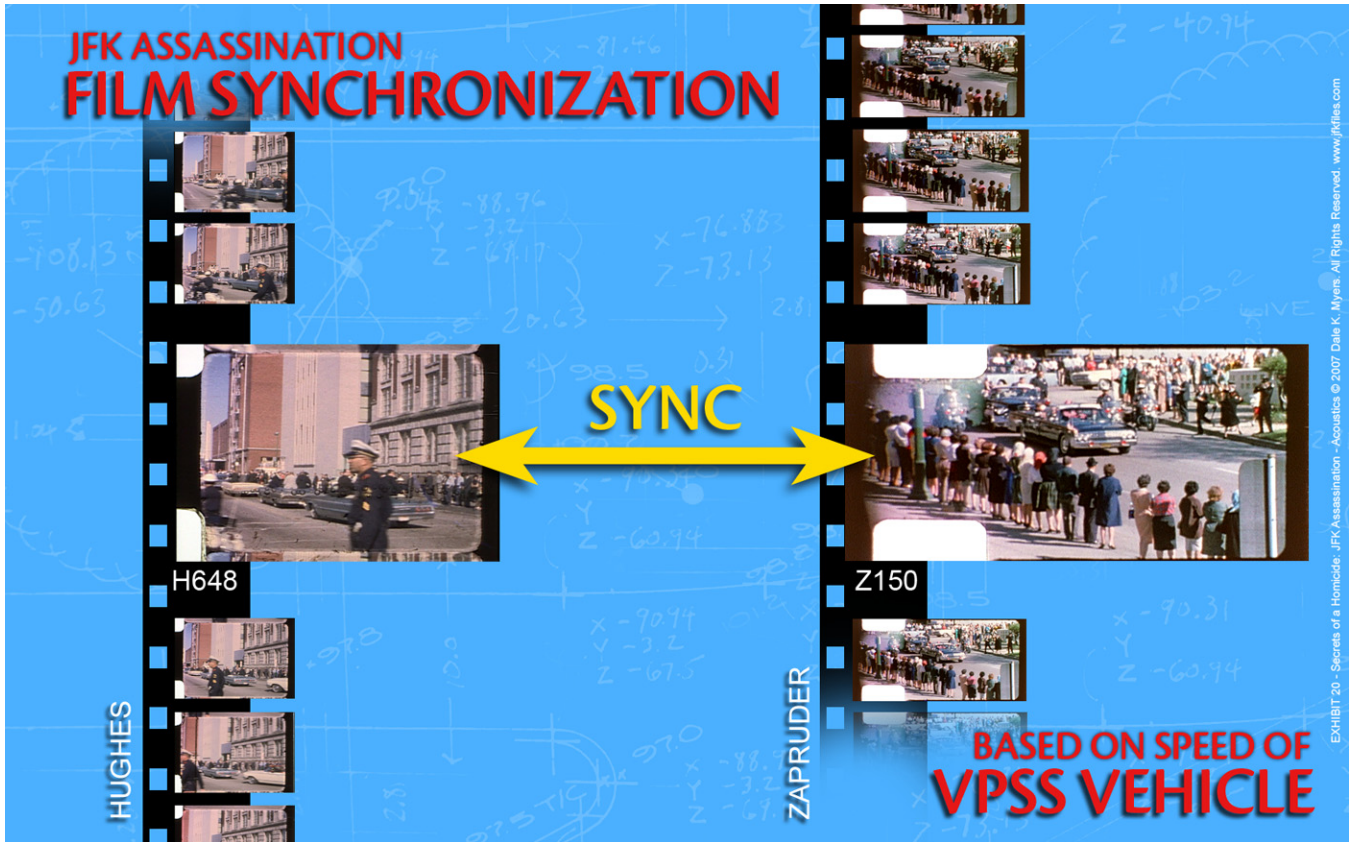


Exhibit 20. One frame (+/- 1 frame) synchronization of Hughes and Zapruder films using speed of VPSS car.

In this case, the unknown variable is the time period between Hughes frame H631 and Zapruder frame Z150. That unknown time period can be determined by using the two known speeds immediately before and after that period. For instance, the speed of the Secret Service vehicle immediately prior to Hughes frames H631 was determined to be 13.58 feet/sec (9.3 mph); while its speed immediately after Zapruder frame Z150 was found to be 10.56 feet/sec (7.2 mph).

Using these two known speeds, the average speed of the Secret Service vehicle between Hughes frame H631 and Zapruder frame Z150 can be calculated as 12.07 feet/sec (8.2 mph).¹¹⁵ At that speed, the Secret Service vehicle would have traversed the known distance of 11.5 feet between Hughes frame H631 and Zapruder frame Z150 in 0.95 seconds; or, the equivalent of 17 frames. ^[Exhibit 19] Hughes frame H631 plus an additional 17 frames equals Hughes frame H648. Hence, Hughes frame H648 is the equivalent of Zapruder frame Z150 (+/- one frame). ^[Exhibit 20] It should be noted that this single synchronization point falls within the range previously calculated.

Five additional reference points common to both the Zapruder and Hughes films – all of which provide a means of independently synchronizing the two films – validate and confirm the synchronization of Hughes frame H648 to Zapruder frame Z150 (+/- one frame), thus providing corroboration for the accuracy of this conclusion. These five validating synchronizations are the result of an analysis of the trajectory and speed of the presidential limousine, Camera Car 1, Camera Car 2, Dallas police motorcyclist Marion L. Baker, and eyewitness Rosemary Willis, as depicted in the nine amateur films listed earlier. [See, *Appendix I* for a complete analysis.]

McLain's Position at the Time of the Assassination

The geometric analysis of the photographic record demonstrates that Dallas police motorcyclist H. B. McLain was near the crosswalk at Main and Houston at the time that Hughes frame H648 and Zapruder frame Z150 were exposed.

To determine McLain's precise location at the moment the Hughes-Zapruder frames H648/Z150 were exposed, a computer model of the motorcycle was positioned to match Hughes frame H648 (the last frame of the Hughes film in which McLain appears) by noting the motorcycle's relationship to lines-of-sight drawn between Hughes' camera and the northwest and southwest corners of the Dal-Tex Building. ^[Exhibit 21] The distance between McLain's location at Hughes H648 and the southern-most edge of the 18-foot diameter acoustic zone where McLain *had to be located* for the acoustic experts' central premise to be valid, was measured at 174.38 feet. ^[Exhibit 22]

115. Calculated as $13.58 \text{ f/s} + 10.56 \text{ f/s} = 24.14 \div 2 = 12.07 \text{ feet/sec}$ (8.2 mph)

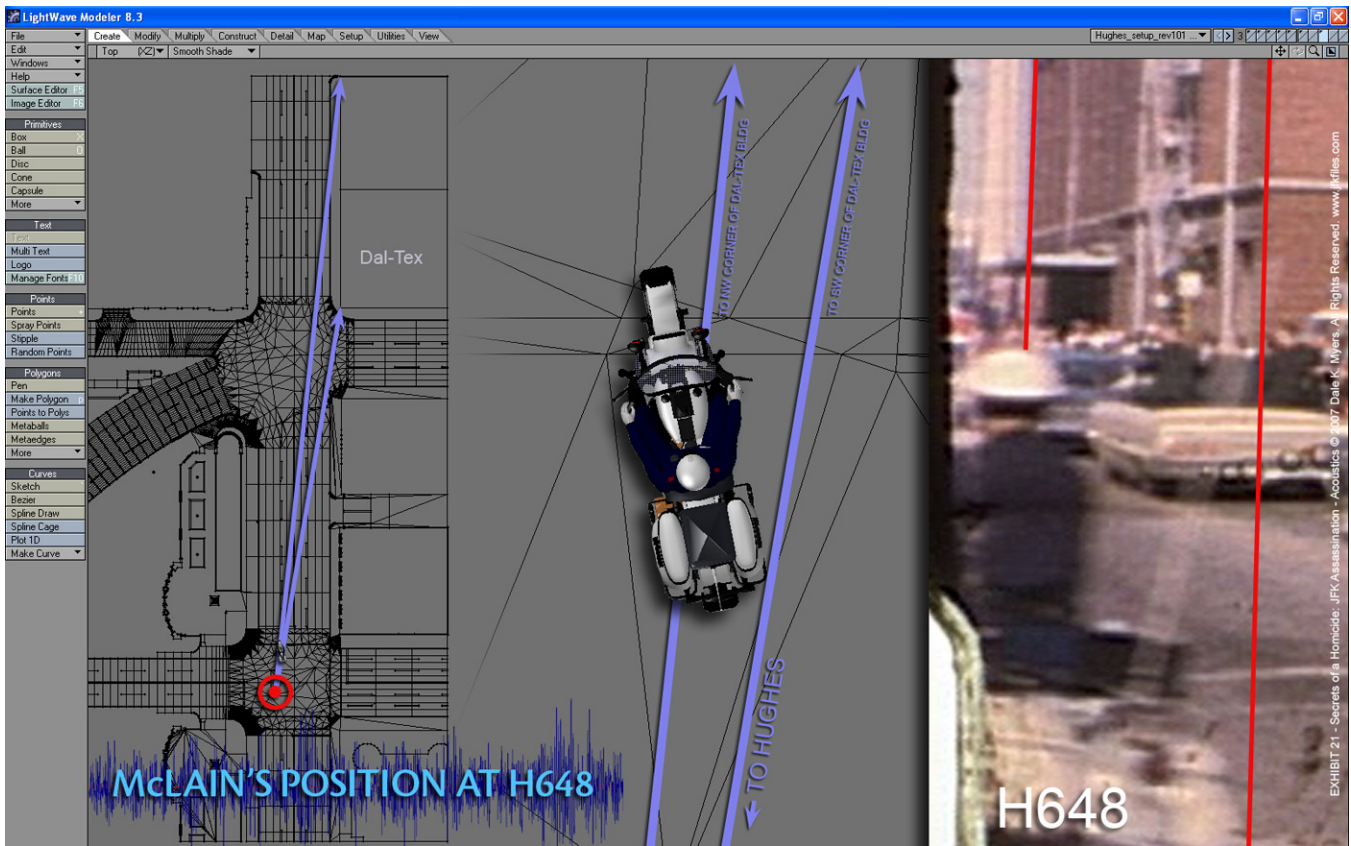


Exhibit 21. H.B. McLain's position at Hughes frame H648.



Exhibit 22. Relative positions of H.B. McLain and the presidential limousine at the equivalent of H648/Z150.

According to the acoustic experts, the first shot was fired at the equivalent of Zapruder frame Z160, just ten frames or 0.546 seconds after McLain had reached the crosswalk at Main and Houston; the position he occupied at Hughes frame H648 and Zapruder frame Z150.

In order for McLain to cover the 174.38 feet between his position at Main and Houston and the first shot position at Elm and Houston in the allotted 0.546 seconds, McLain would have to average a speed of 198 mph.¹¹⁶ Since the Harley-Davidson motorcycle McLain was riding had a top speed of 95 mph, it would be physically impossible for McLain to cover the distance in the time specified.

Of course, McLain would actually have to travel much faster than the *average* speed calculated given the fact that McLain's known speed at H648-Z150 was 14.7 m.p.h. and the presumed speed of the open microphone between shots 1 and 2, according to the acoustic experts, was 10.5 mph.¹¹⁷ Simply put, McLain would be required to accelerate from 14.7 mph to a speed *significantly greater than 198 mph* (calculated to be approximately 2,115.4 mph – nearly three times speed of sound – in 0.2 seconds) and then slow down to 10.5 m.p.h. during the allotted 0.6 seconds. In either case, the required speed would be impossible to achieve on a motorcycle.

Consequently, Officer H.B. McLain could *not* possibly have been the motorcyclist with the open microphone at the location specified by HSCA acoustic experts.

What about another motorcycle officer? Could another motorcycle officer have been in a position to transmit the impulse sounds believed to have been gunshots as the acoustic experts postulated? The answer is - *no*. The filmed record clearly shows that there were no other motorcycle officers between the presidential limousine and Officer McLain at the time the shots was fired, and therefore, no motorcycle officers could have been in the position dictated by the acoustic evidence. ^[Exhibit 23]

116. Calculated as $174.38 \text{ ft} \div 0.6 \text{ sec} = 290.6 \text{ ft/per/sec}$ (198.2 mph)

117. This speed was later refined by Dr. James Barger to "about 8 mph." (Letter, Dr. James Barger to Norman Ramsey, February 2, 1982) A reduction in speed between shots one and two, as cited by Barger, would necessitate a considerable *increase* in speed, above and beyond the impossible speed already calculated.



Exhibit 23. Composite frame illustrating that no motorcycles were between McLain and the limousine escorts.

CONCLUSION

The reconstructed photographic record conclusively demonstrates that no police motorcycles – including, Officer H.B. McLain’s – were near the area designated by the HSCA’s acoustic experts, and consequently, the committee’s acoustic evidence of a conspiracy in the Kennedy assassination is invalid.

This finding, based on the photographic record alone, supports and is consistent with the conclusions reached by the 1982 National Academy of Science’s Committee on Ballistic Acoustics which determined that the recorded segment analyzed by the HSCA acoustic experts was recorded at least one minute after the assassination, and therefore, could not have contained “gunshots.”

APPENDIX I

FIVE ADDITIONAL REFERENCE POINTS COMMON TO THE ZAPRUDER AND HUGHES FILMS CONFIRM THE VALIDITY OF SYNCHRONIZING HUGHES FRAME H648 TO ZAPRUDER FRAME Z150

Five additional reference points common to both the Zapruder and Hughes films – all of which provide a means of independently synchronizing the two films – validate and confirm the synchronization of Hughes frame H648 to Zapruder frame Z150 (+/- one frame), thus providing corroboration for the accuracy of this conclusion. These five validating synchronizations are the result of an analysis of the trajectory and speed of the presidential limousine, Camera Car 1, Camera Car 2, Dallas police motorcyclist Marion L. Baker, and eyewitness Rosemary Willis, as depicted in the nine amateur films listed earlier.

The methods and processes used to identify the synchronization point between the Hughes and Zapruder films in the instances listed are as follows:

(SEC-1) The trajectory and speed of the presidential limousine as depicted in the Tina Towner film is consistent with Hughes frame H648 synchronizing to Zapruder frame Z150.

An amateur 8mm film made by Tina Towner, who was standing at the southwest corner of Elm and Houston, depicts the presidential limousine as it turned from Houston onto Elm Street shortly before the assassination. A study of this film was undertaken to determine how the Towner film synchronized to other films taken during this same period and whether that synchronization was consistent with the hypothesis that Hughes frame H648 was the equivalent of Zapruder frame Z150.

The Tina Towner film consists of 1 pre-assassination sequence and 1 post assassination sequence, totaling 286 frames. The one pre-assassination sequence is the focus of this analysis. This sequence depicts the presidential limousine turning from Houston onto Elm Street and continuing a short distance down Elm. It contains a total of 160 frames, identified as Towner frames T001 through T160. There are no camera stops and 1 splice during this sequence.

Computer models and composite frames were used to determine the speed and trajectory of the presidential limousine, and thus determine how much time is missing due to the film splice. The single splice at T084-T085 was subsequently identified as having 7 frames missing. ^[Exhibit 24]

A careful comparison of scenes depicted in the Towner, Dorman, Bell, Hughes and Zapruder films – in particular, the speed at which the presidential limousine was traveling –

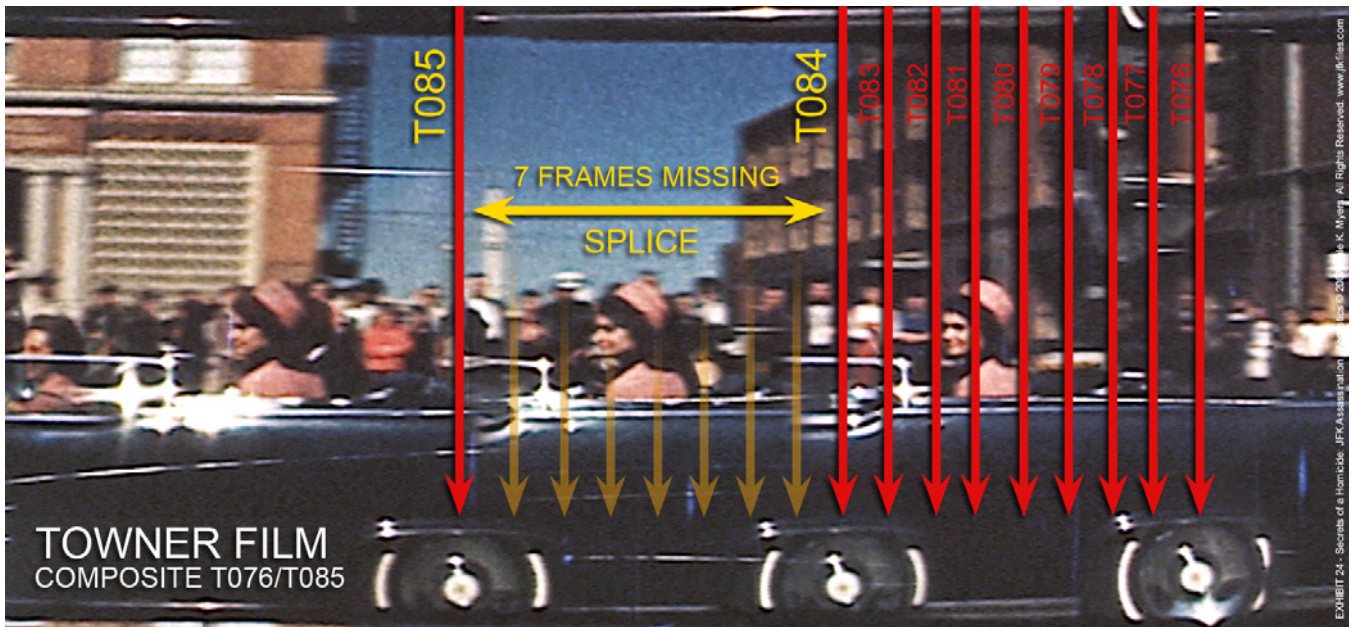


Exhibit 24. Plotting the progression of the limousine determined that 7 frames were missing at the splice.

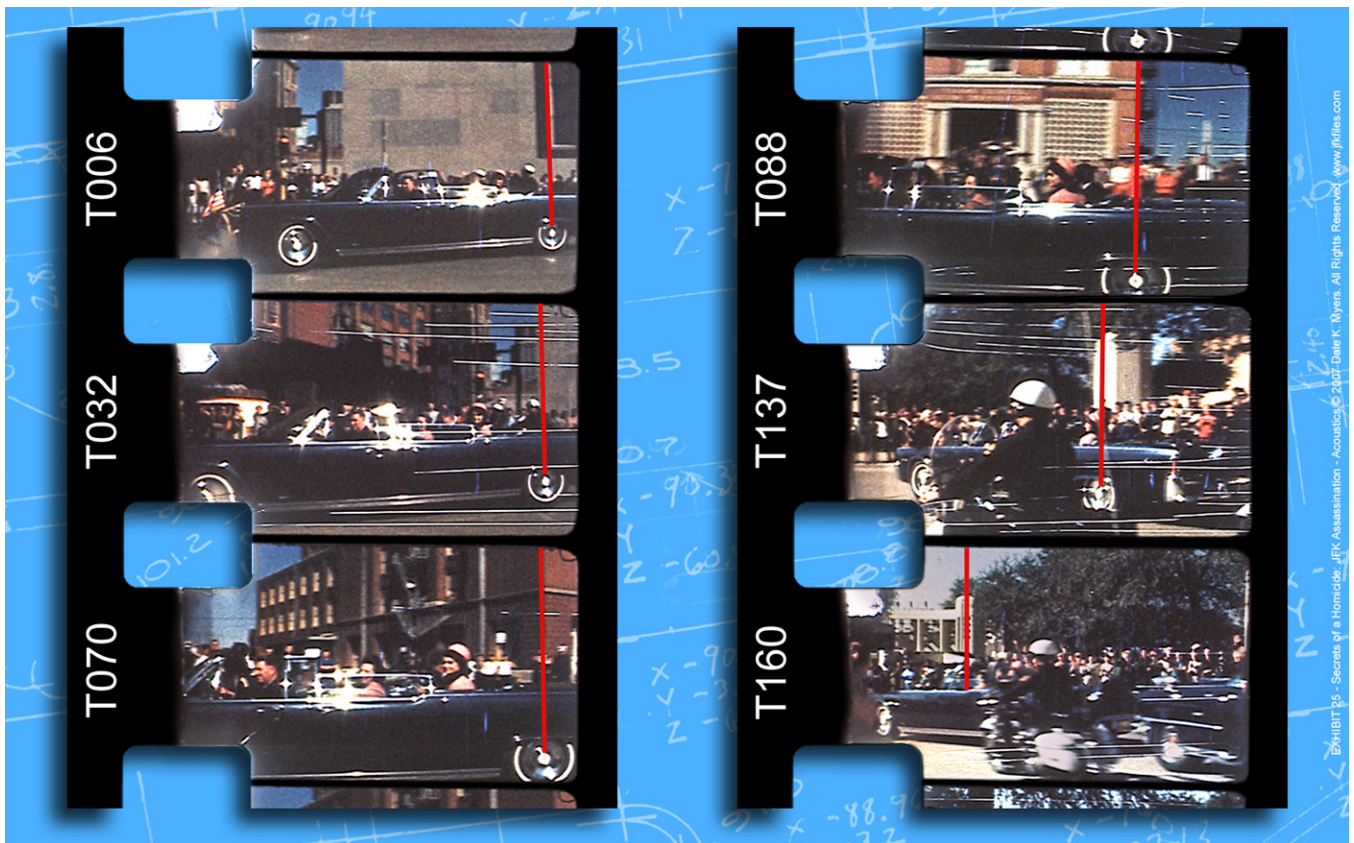


Exhibit 25. Plotting the position of the presidential limousine in the Towner film.

demonstrates that the Towner camera was running at an average speed of 22.8 frames/sec, relative to Zapruder's camera.¹¹⁸

Two films and one photograph depict Tina Towner's location at the time her film was made – films by Elsie Dorman and Abraham Zapruder; and a still photograph taken by Hugh Betzner. [The Betzner photograph was the second in a series of black and white photos he took that day.¹¹⁹] Tina Towner's precise position at the corner of Elm and Houston was determined by cross plotting Dorman, Zapruder, and Betzner's lines of sight of Towner on a computer model of Dealey Plaza.¹²⁰ A virtual camera was then placed at the position indicated, and the camera's settings adjusted to match Towner's field-of-view, as depicted in her film.

A computer model of the presidential limousine was then incorporated into the scene and motion matched to precisely track the motion of the president's limousine as depicted in the Towner film. Key frames were established at Towner frames T006, T032, T070, T088, and T160. The limousine's position was fixed at each specified frame by plotting a line-of-sight between Towner's camera and one of several fixed objects in Dealey Plaza, and aligning the limousine model to that line-of-sight. [Exhibit 25]

Four additional virtual cameras were created to match the position and field-of-view of four other amateur film makers – Elsie Dorman, F.M. "Mark" Bell, John Martin, Jr., and Robert Hughes. These additional vantage points, which show the presidential limousine (Bell, Martin, and Hughes) and Towner filming (Dorman) during this period, make it possible to precisely align these four additional films with the Towner sequence.

Finally, a sixth virtual camera, depicting the field-of-view of Abraham Zapruder's camera was added to the computer model to establish the relationship between the Towner sequence and the Zapruder film.

Using these six films – Towner, Dorman, Bell, Martin, Hughes and Zapruder – to triangulate the trajectory and speed of the presidential limousine, it was determined that:

(a) The first frame of the Towner pre-assassination sequence (T001) synchronizes to Hughes frame H526; and the last frame of the Towner sequence (T160) synchronizes to Hughes frame H622. [Exhibit 26]

118. Gary Mack, curator of the Sixth Floor Museum, supervised the video transfer of the original Towner film and reported that it required a higher playback rate than other amateur films transferred by the museum. The rate used for the museum transfer was determined to be 20.2 frames-per-second. [Telephone conversation with Gary Mack, February 12, 2003 (Note: The Boston transfer facility utilized a variable speed projector capable of adjusting the playback speed +/- 10% of the standard setting of 18 fps. This allowed playback speeds of approximately 16 to 20 frames per second. Mack reported that the Towner film didn't "look right" until pushed to approximately 20 fps. Asked if he had pushed the speed to 24 fps to see if it looked better, Mack said he couldn't recall, but he didn't think so.)]

119. Trask, Richard B., *Pictures of the Pain*, Yeoman Press, 1994, pp. 160, 221 note 6

120. Towner's position in the Zapruder film was deduced by comparing the crowd at the corner of Elm and Houston as seen in a pre-assassination sequence with other films and photographs of the same area.

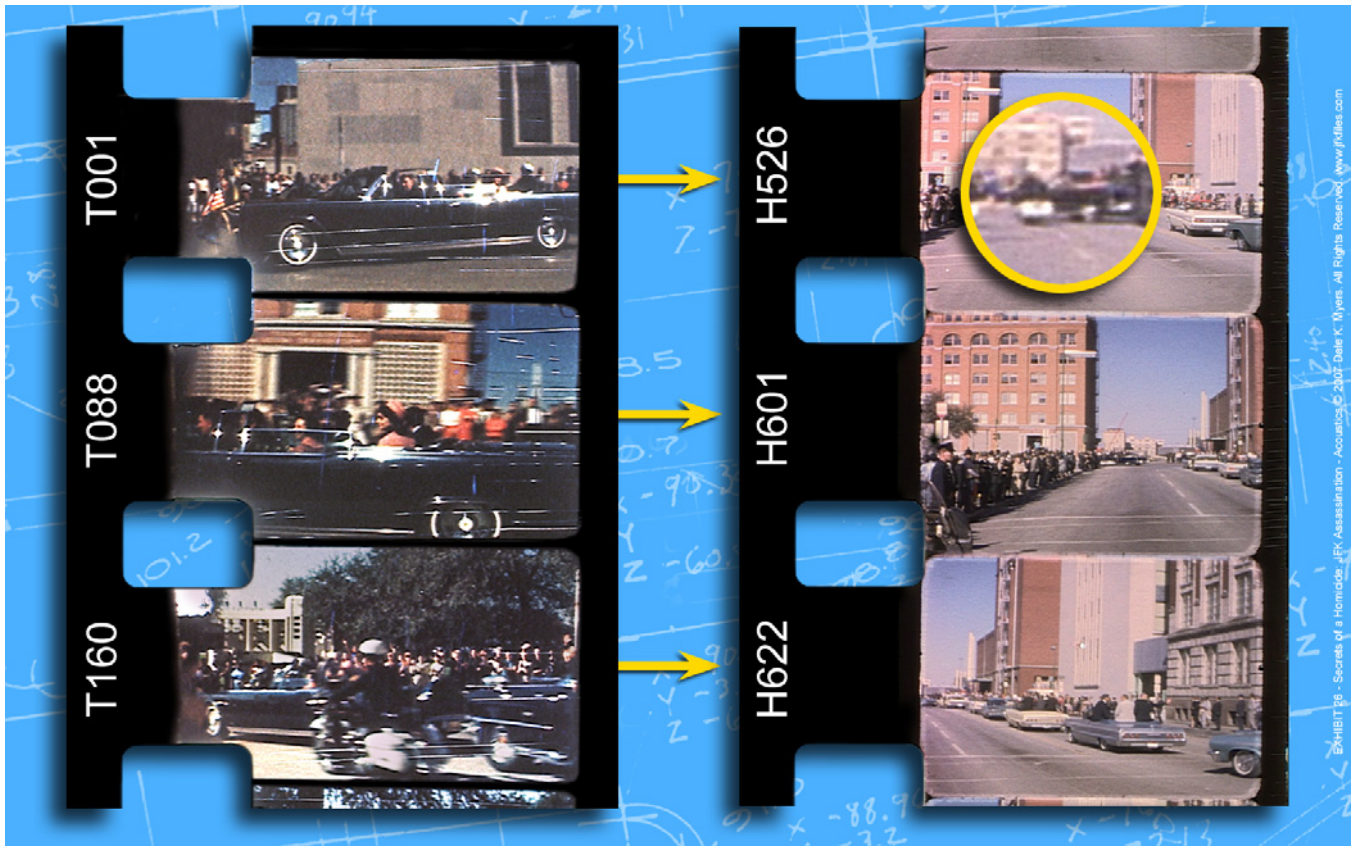


Exhibit 26. Synchronization of the Towner film to the Hughes film

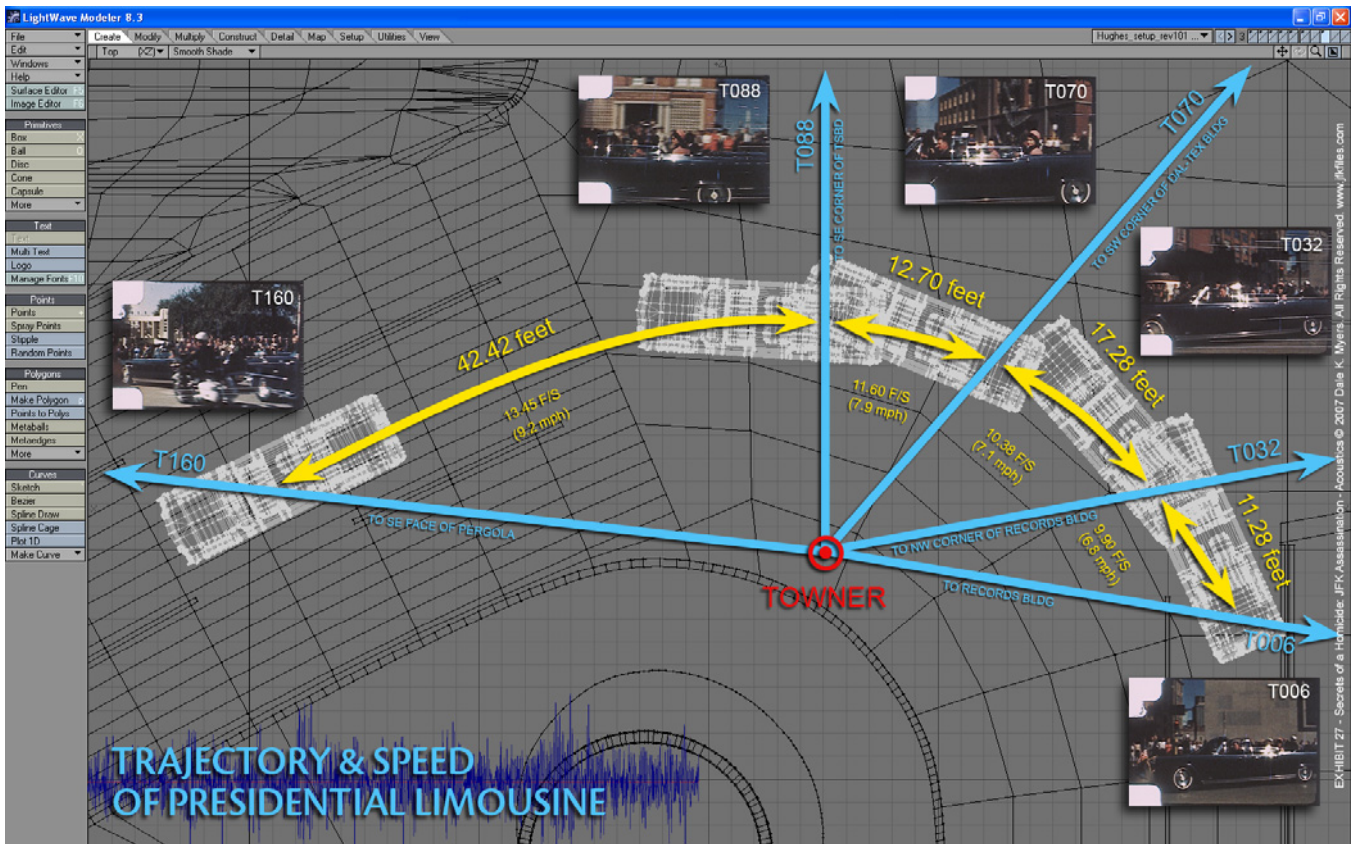


Exhibit 27. Calculated speed of the presidential limousine as it turns from Houston onto Elm Street.

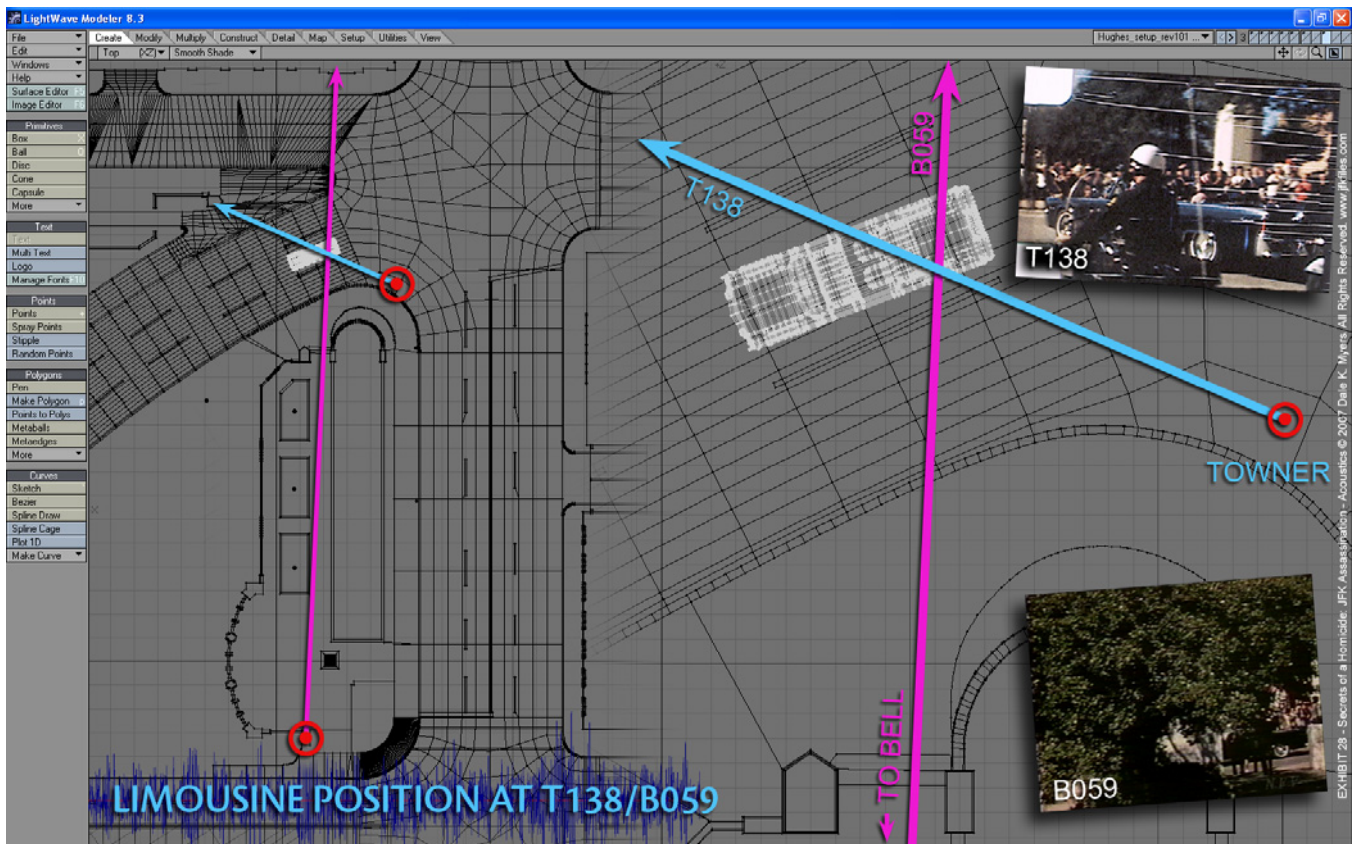


Exhibit 28. Synchronization of Towner frame T138 to Bell frame B059 based on limousine position.

(b) The presidential limousine was found to be traveling at 6.8 mph as the Towner sequence begins; increased to 7.1 mph; increased speed to 7.9 mph as it passed the front entrance of the Texas School Book Depository, and further accelerated to 9.2 mph as the sequence ends.

These calculated speeds are consistent with those depicted in and calculated from the Dorman, Bell, Martin, Hughes and Zapruder films. [Exhibit 27]

(c) Towner frame T138 synchronizes with Bell frame B059 as demonstrated by the position of the presidential limousine, which can be fixed by projecting a line of sight from both camera positions through the left rear wheel of the limousine.

Towner frame T138 and Bell frame B059 also synchronize precisely with Dorman frame D307, which depicts Rosemary Willis about to cross both F.M. “Mark” Bell and John Martin, Jr.’s field-of-view. [See SEC-5, p.76] [Exhibit 28]

(d) Towner frame T160 synchronizes to a moment equal to 0.82 seconds prior to Zapruder frame Z133.



Exhibit 29. Plotting the position of the presidential limousine at Zapruder frames Z150 and Z175.

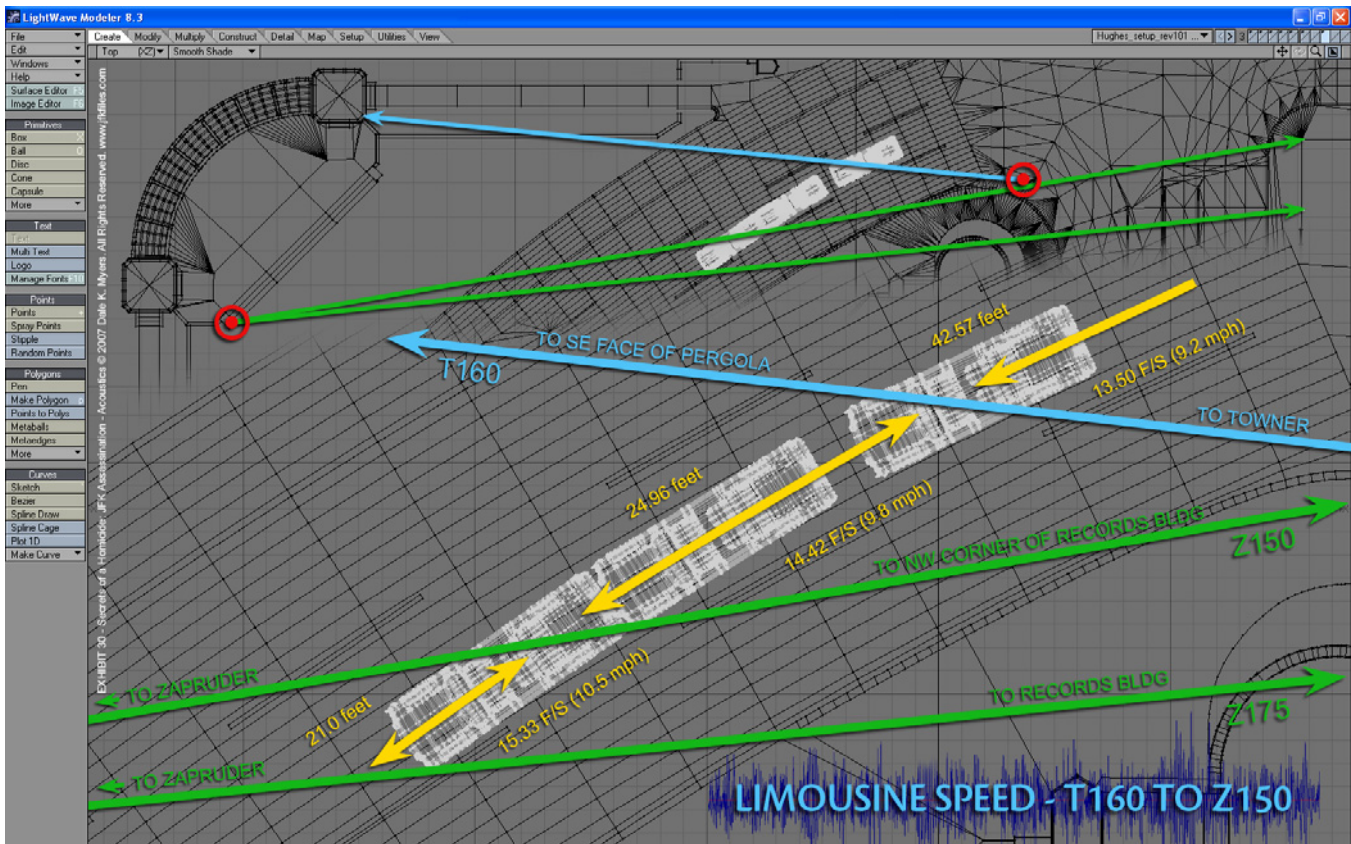


Exhibit 30. Synchronization of the Towner film to the Zapruder film based on the speed of the limousine.

This can be determined as follows: The speed of the presidential limousine during the last moments of the Towner sequence (T088 to T160) was determined to be 13.50 feet/sec (9.2 mph). The speed of the limousine between Zapruder frames Z150 and Z175 was determined to be 15.33 feet/sec (10.5 mph). Computer models show that the distance traversed by the limousine between Towner frame T160 and Zapruder frame Z150 was 24.96 feet. If the limousine was moving at a speed of 14.42 feet/sec (9.8 mph), the computed average of the two known speeds of 9.2 and 10.5 mph, the limousine would have covered the 24.96 foot distance in 1.73 seconds. This is the equivalent of 32 Zapruder frames ($1.73 \times 18.3 = 32$). Subtracting 32 frames from Z150 yields the hypothetical Zapruder frame Z118;¹²¹ or, 0.82 seconds before Zapruder frame Z133. [Exhibit 29 & 30]

Since Towner frame T160 synchronizes to Hughes frame H622 [See SEC-4 (a), p.69], the projected trajectory of the presidential limousine between Towner T160 and Zapruder Z150 shows that Zapruder frame Z150 would equal a moment 1.73 seconds after Hughes H622. Given the 6 frame camera stop between Hughes frames H630 and H631 [See SEC-1, p.53], this 1.73 second time period would be reduced by 0.33 seconds. The resulting figure of 1.4 seconds equals 26 frames ($1.4 \times 18.3 \text{ frames/second} = 26$). Consequently, Z150 is the equivalent of Hughes frame H648 ($H622 + 26 = 648$).

In conclusion, the four calculations above demonstrate that the trajectory and speed of the presidential limousine as depicted in the Towner film, is consistent with the speed of the limousine as seen in the Hughes, Dorman, Bell, Martin, and Zapruder films. The ability to motion track the position of the limousine using computer models and thus synchronize all five films under discussion again proves that Hughes frame H648 synchronizes to Zapruder frame Z150.

(SEC-2) The trajectory and speed of the Camera Car 1 (the tenth car in the motorcade) as depicted in the Robert Hughes film is consistent with Hughes frame H648 synchronizing to Zapruder frame Z150.

An amateur 8mm film made by Robert J.E. Hughes Jr., who was standing in the intersection at Main and Houston, depicts the presidential limousine as it turned from Main onto Houston; proceeds north to Elm; and turns from Houston onto Elm Street shortly before the assassination. The parade of motorcade vehicles trailing the presidential limousine is also seen in the Hughes film. A study of the movements of Camera Car 1 (the tenth car in the motorcade) was undertaken to determine if those movements were consistent with the hypothesis that Hughes frame H648 was the equivalent of Zapruder frame Z150.

121. This is a hypothetical Zapruder frame used for reference only and simply provides a means of measuring time prior to Z133, the first frame depicting the presidential limousine.



Exhibit 31. Examples of the effect of a camera stop and a splice on frames of the Hughes film.

The Robert Hughes film consists of 18 sequences, 8 pre-assassination and 10 post assassination scenes. Sequence 5 is the first that depicts the presidential limousine, which appears on Main Street, approaching the Houston Street corner. Sequences 6, 7 and 8 depict the limousine as it turns from Main onto Houston, travels north on Houston, and turns onto Elm Street. These three sequences cover frames H259 through H680 and are the focus of this study. There are 3 camera stops and 2 splices between these two points.

The camera stops are easily identified in all films by a break in the action accompanied by a single, slightly over exposed frame (the result of the camera mechanism taking a fraction of a second to reach operating speed, thereby causing the first frame to be exposed to light longer than normal) marking the beginning of the sequence that follows the camera stop. Splices are also easily identified in all films by a break in the action accompanied by a splice line and artifacts (i.e., bubbles, discoloring, etc.) which are the result of taping or gluing two film ends together. [Exhibit 31]

A careful comparison of scenes depicted in the Hughes and Zapruder films – in particular, the speed at which motorcade vehicles common to both films are traveling – demonstrates that the Hughes camera was operating at a speed equal to Zapruder’s camera – an average of 18.3 frames/second. For all Hughes camera computations, the 18.3 frames/second figure was used.

Computer models were used to examine the speed and trajectory of the motorcade vehicles, and thus determine how much time elapsed between camera stops and how much time is missing due to film splices. The three camera stops were subsequently identified as H525-H526 (131 frame stop); H613-H614 (37 frame stop); and H630-H631 (6 frame stop). The two splices were identified as H315-H316 (3 missing frames), and H648-H649 (3 missing frames).

Robert Hughes' precise position in the middle of the intersection of Main and Houston was determined by matching the Hughes camera's field-of-view with a computer model of Dealey Plaza. This was accomplished by using a technique known as *triangulation*, [See *Triangulation*, p.42] which involved creating a virtual camera, placing it into a computer model of Dealey Plaza, and making adjustments to the virtual camera's six degrees of movement until the camera's view of the computer model matched the Hughes film frame-for-frame. Using this method, Hughes' location was determined to be 8.83 feet south of the center line of Main Street and 15.5 feet west of the center line of Houston Street.

A second virtual camera, matching Zapruder's field-of-view, was also added to the computer model of Dealey Plaza.

Using the Hughes and Zapruder films, as well as measurements obtained from a computer model of Dealey Plaza, it was possible to triangulate the trajectory and speed of Camera Car 1, and thus, synchronize the two films. The results show that:

(a) Camera Car 1's estimated speed as it turned from Main onto Houston Street was calculated to be 11.56 feet/second (7.9 mph).

Since Camera Car 1 is not visible in the Hughes film making the turn in question, the speed of the Camera Car 1 was based on an average obtained from the two vehicles trailing immediately behind it – Camera Cars 2 and 3. The speeds of those two trailing vehicles were determined by counting the number of frames it took for both vehicles to traverse their own length. All three camera cars were 1964 Chevrolet Impalas which had an overall length of 209.9 inches (17.5 feet).¹²² Camera Car 2 was found to be traveling at 10.35 feet/second (7.1 mph) between Hughes frames H614-H639; [Exhibit 32] and Camera Car 3 was found to be traveling at 12.77 feet/second (8.7 mph) between Hughes frames H618-H637. [Exhibit 33] The average of these two speeds (7.9 mph) was applied to Camera Car 1.

(b) Camera Car 1's speed between Zapruder frames Z213-Z236 was calculated to be 13.89 feet/second (9.5 mph).

An enlarged and stabilized Zapruder film sequence was created for this analysis. Camera Car 1 is visible above the concrete wall in the background of Zapruder frame sequence

122. Gunnell, John, *Standard Catalog of American Cars, 1946-1975, Revised 4th Edition*, Krause Publications, 2002, p.182

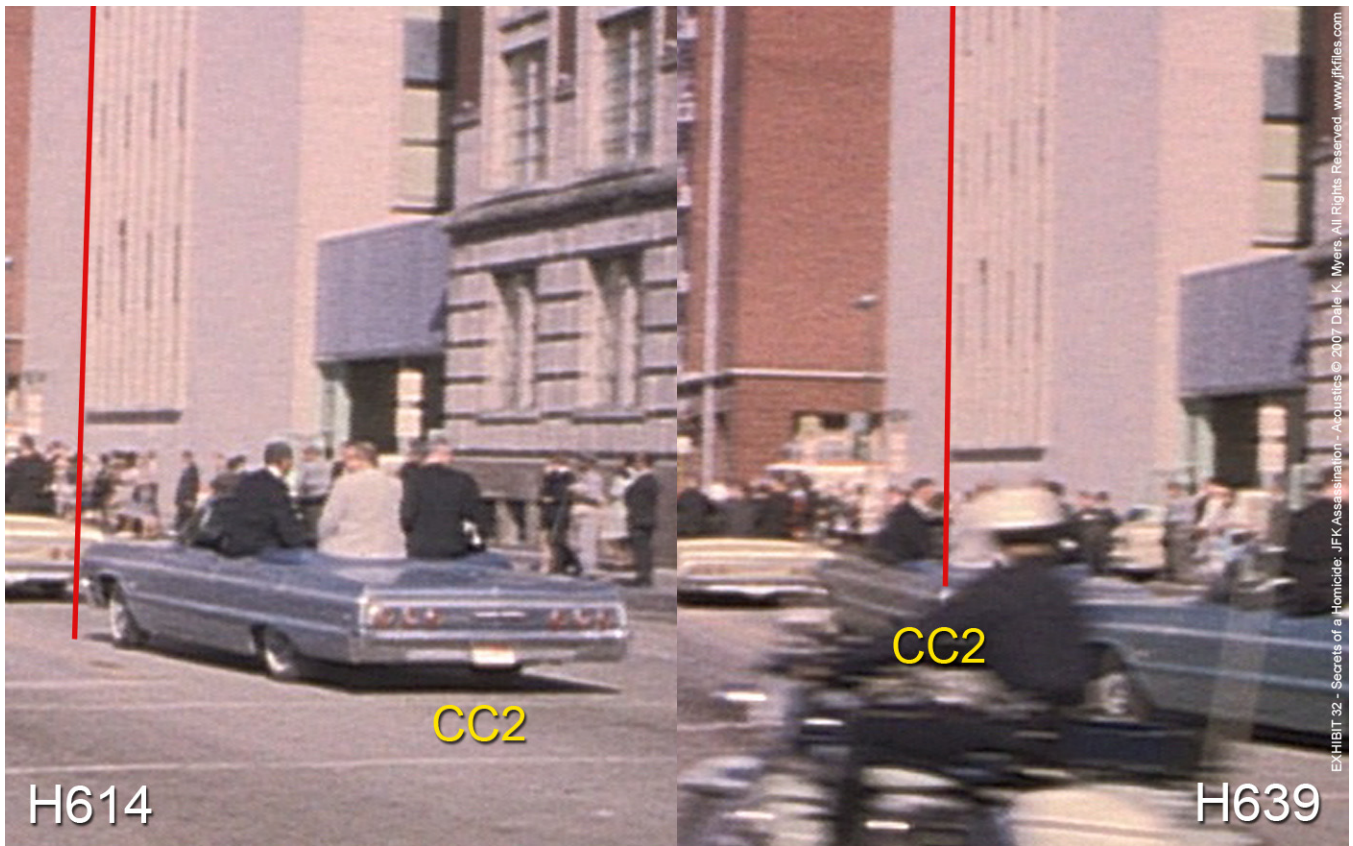


Exhibit 32. Plotting the position of Camera Car 2 at Hughes frames H614 and H639.



Exhibit 33. Plotting the position of Camera Car 3 at Hughes frames H618 and H637.

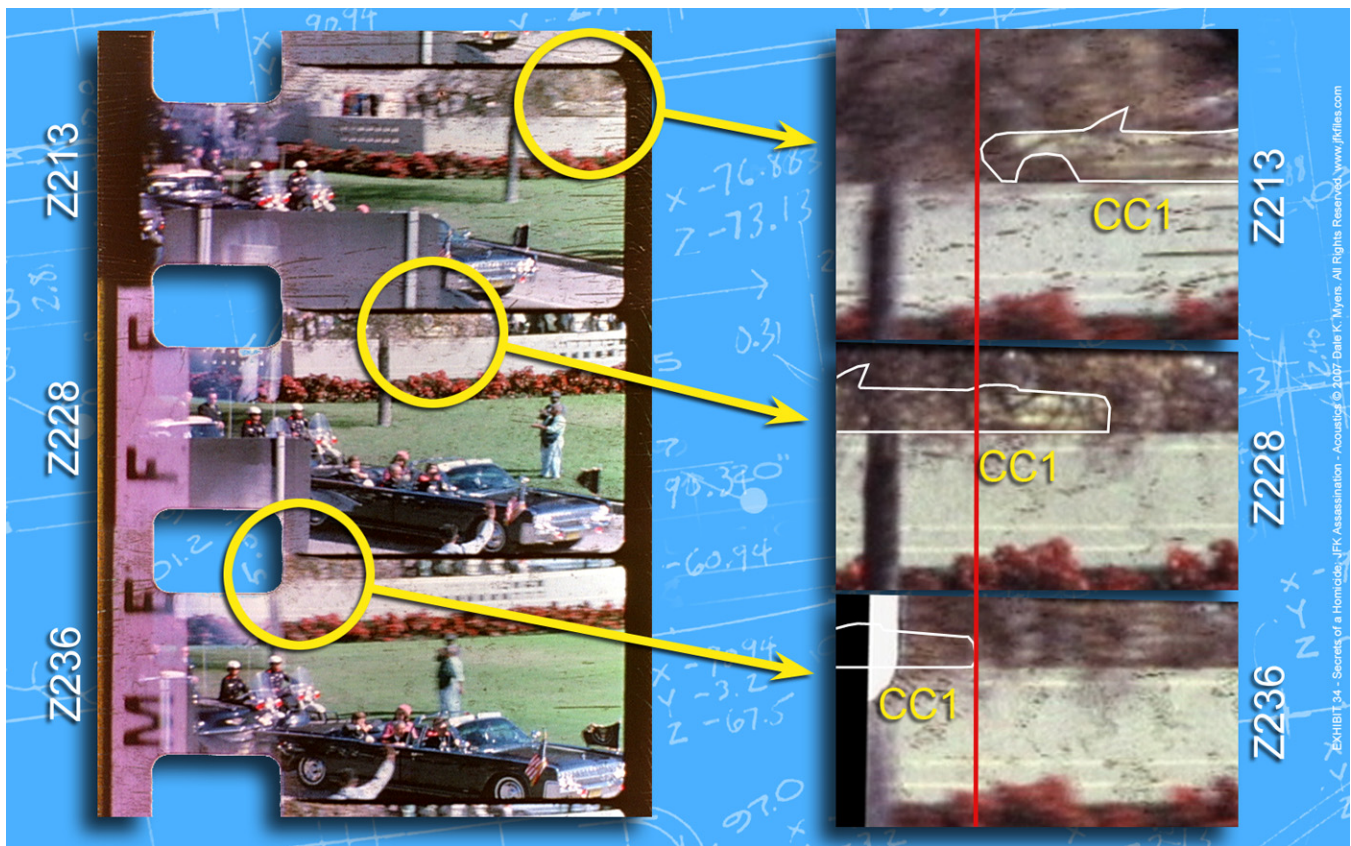


Exhibit 34. Plotting the distance traversed by Camera Car 1 between Zapruder frames Z213 and Z236.

Z213-Z236. During that period, Camera Car 1 – a 1964 Chevrolet Impala – traverses its own overall length of 17.5 feet in 23 frames. ^[Exhibit 34] Dividing the speed of the Zapruder camera (18.3 frames/second) into the frame count yields a time of 1.26 seconds. This calculates to a speed of 13.89 feet/second (9.5 mph).

(c) A computer model of the position of Camera Car 1 at Hughes frame H648 and Zapruder frame Z214 shows that it traverses a distance of 44.54 feet.

A computer model of Camera Car 1 was positioned to match Hughes frame H648 by noting the vehicle's relationship to a line-of-sight drawn between Hughes' camera and the southwest corner of the Dal-Tex Building. A computer model of Camera Car 1 was also positioned to match Zapruder frame Z214 by noting the vehicle's relationship to a line of sight drawn between Zapruder's camera and the tree trunk in the northern-most planter box adjacent to the reflecting pool. ^[Exhibit 35] The distance between these two positions (rear bumper-to-rear bumper) was measured at 44.54 feet.

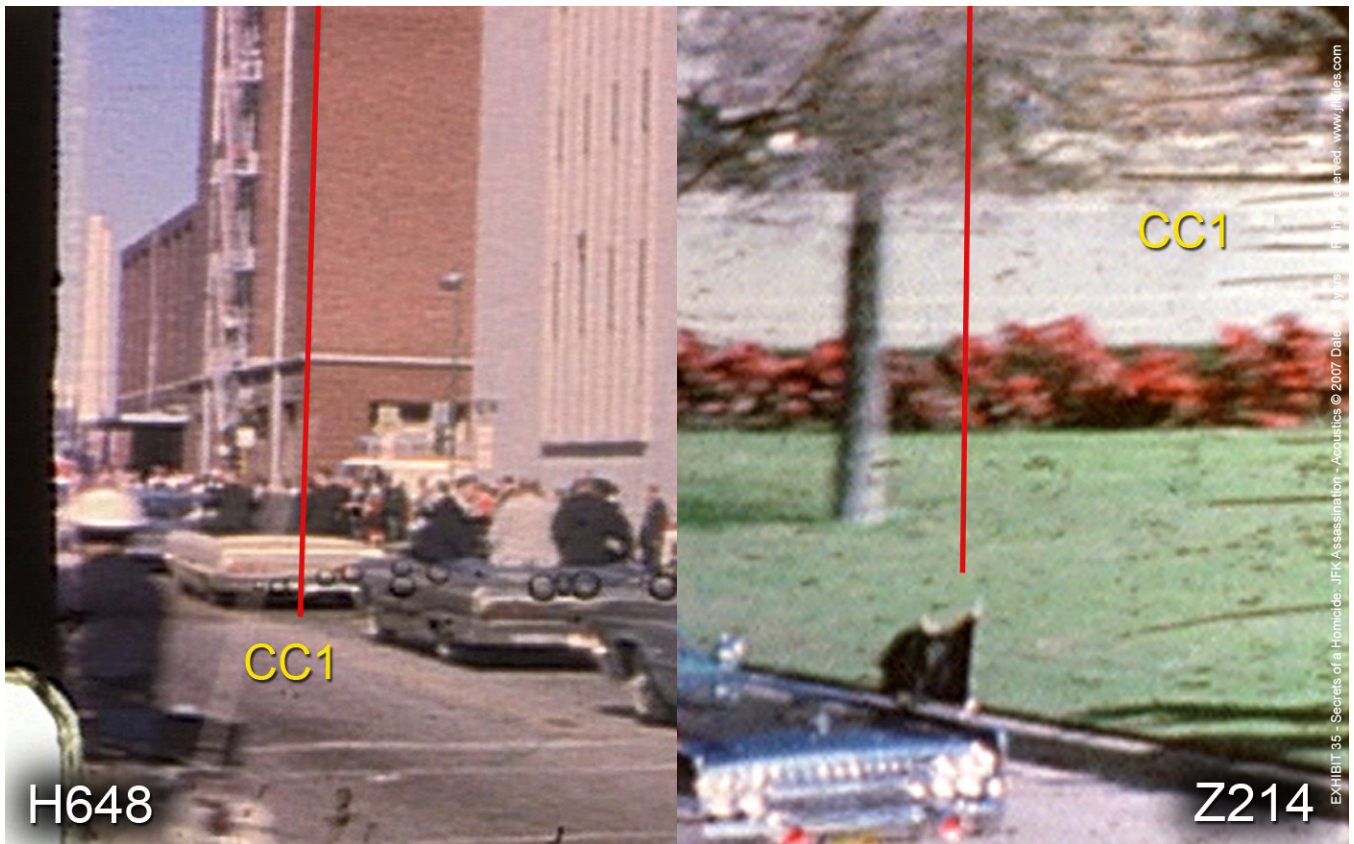


Exhibit 35. Plotting the position of Camera Car 1 at Hughes frame H648 and Zapruder frame Z214.

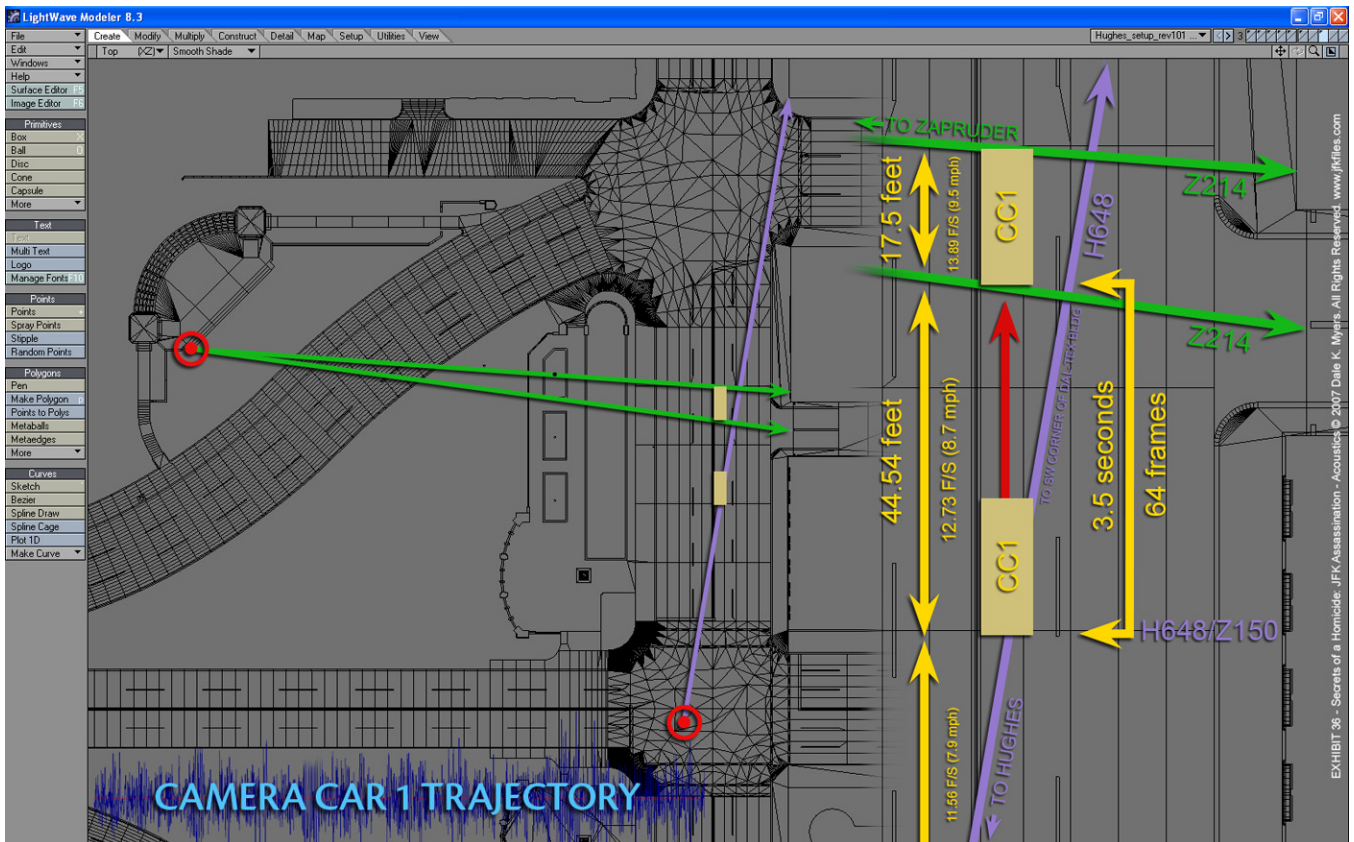


Exhibit 36. Plotting the distance traversed by Camera Car 1 between Hughes H648 and Zapruder Z214.

(d) Camera Car 1 would have traversed the 44.54 feet between Hughes frame H648 and Zapruder frame Z214 in 3.5 seconds traveling at an estimated speed of 12.73 feet/second (8.7 mph).

The estimated speed of Camera Car 1 during this period was an average speed calculated from Camera Car 1's initial speed on Houston Street of 11.56 feet/second (7.9 mph) [See (a) above.] and its known speed between Zapruder frames Z213-Z236 of 13.89 feet/second (9.5 mph). Dividing the distance of 44.54 feet by the estimated speed of 12.73 feet/second (8.7 mph) yields a time period of 3.5 seconds. ^[Exhibit 36]

In conclusion, the four calculations above demonstrate that Camera Car 1 would have traversed the 44.54 foot distance between its known positions at Hughes frame H648 and Zapruder frame Z214 in 3.5 seconds. This time period is equal to 64 Zapruder frames ($3.5 \times 18.3 = 64$). Consequently, Hughes frame H648 is the equivalent of Zapruder frame Z150 ($Z214 - 64 = Z150$).

(SEC-3) The trajectory and speed of the Camera Car 2 (the eleventh car in the motorcade) as depicted in the Robert Hughes film is consistent with Hughes frame H648 synchronizing to Zapruder frame Z150.

A study of the movements of Camera Car 2 (the eleventh car in the motorcade) was undertaken to determine if those movements were consistent with the hypothesis that Hughes frame H648 was the equivalent of Zapruder frame Z150.

For a complete description of the Robert Hughes film, the camera running speed, and method of resolving Hughes' camera position, see SEC-2, pp.60-61.

A virtual camera matching the position and field-of-view of the Hughes camera was placed into a computer model of Dealey Plaza. [See SEC-2, pp.60-61, above for the complete methodology.] A second virtual camera, matching the Zapruder camera's field-of-view, was also added to the computer model.

Using the Hughes and Zapruder films, as well as measurements obtained from a computer model of Dealey Plaza, it was possible to triangulate the trajectory and speed of Camera Car 2, and thus, synchronize the two films. The results show that:

(a) Camera Car 2's speed as it turned from Main onto Houston Street was calculated to be 10.35 feet/second (7.1 mph).

Camera Car 2 was a 1964 Chevrolet Impala which had an overall length of 209.9 inches (17.5 feet).¹²³ Camera Car 2 was found to traverse its own overall length (17.5 feet) between Hughes frames H614-H639 – a total of 31 frames. Dividing the speed of the Hughes camera (18.3 frames/second) into the frame count yields a time of 1.69 seconds. This calculates to a speed of 10.35 feet/second (7.1 mph). [See Exhibit 32, p.62]

(b) Camera Car 2's speed between Zapruder frames Z229-Z253 was calculated to be 13.36 feet/second (9.1 mph).

An enlarged and stabilized Zapruder film sequence was created for this analysis. Camera Car 2 appears above the concrete wall in the background of Zapruder sequence Z229-Z253. During that period, Camera Car 2 traverses its own overall length of 17.5 feet in 24 frames. Dividing the speed of the Zapruder camera (18.3 frames/second) into the frame count yields a time of 1.31 seconds. This calculates to a speed of 13.36 feet/second (9.1 mph) ^[Exhibit 37]

(c) A computer model of the position of Camera Car 2 at Hughes frame H648 and Zapruder frame Z235 shows that it traverses a distance of 55 feet.

A computer model of Camera Car 2 was positioned to match Hughes frame H648 by noting the vehicle's relationship to a line-of-sight drawn between Hughes' camera and the northwest corner of the Records Building. A computer model of Camera Car 2 was also positioned to match Zapruder frame Z235 by noting the vehicle's relationship to a line-of-sight drawn between Zapruder's camera and the northwest corner of the County Courthouse Building. ^[Exhibit 38] The distance between these two positions (rear bumper-to-rear bumper) was measured at 55 feet.

(d) Camera Car 2 would have traversed the 55 feet between Hughes frame H648 and Zapruder frame Z235 in 4.64 seconds traveling at an estimated speed of 11.86 feet/second (8.1 mph).

The estimated speed of Camera Car 2 during this period was an average speed calculated from Camera Car 2's initial speed on Houston Street of 10.35 feet/second (7.1 mph) [See (a) above.] and its speed between Zapruder frames Z229-Z253 of 13.36 feet/second (9.1 mph). [See (b) above.] Dividing the distance of 55 feet by the estimated speed of 11.86 feet/second (8.1 mph) yields a time period of 4.64 seconds. ^[Exhibit 39]

In conclusion, the four calculations above demonstrate that Camera Car 2 would have traversed the 55 foot distance between its known positions at Hughes frame H648 and Zapruder frame Z235 in 4.64 seconds. This time period is equal to 85 Zapruder frames (4.64 X 18.3 = 85). Consequently, Hughes frame H648 is the equivalent of Zapruder frame Z150 (Z235 – 85 = Z150).

123. Gunnell, John, *Standard Catalog of American Cars, 1946-1975, Revised 4th Edition*, Krause Publications, 2002, p.182

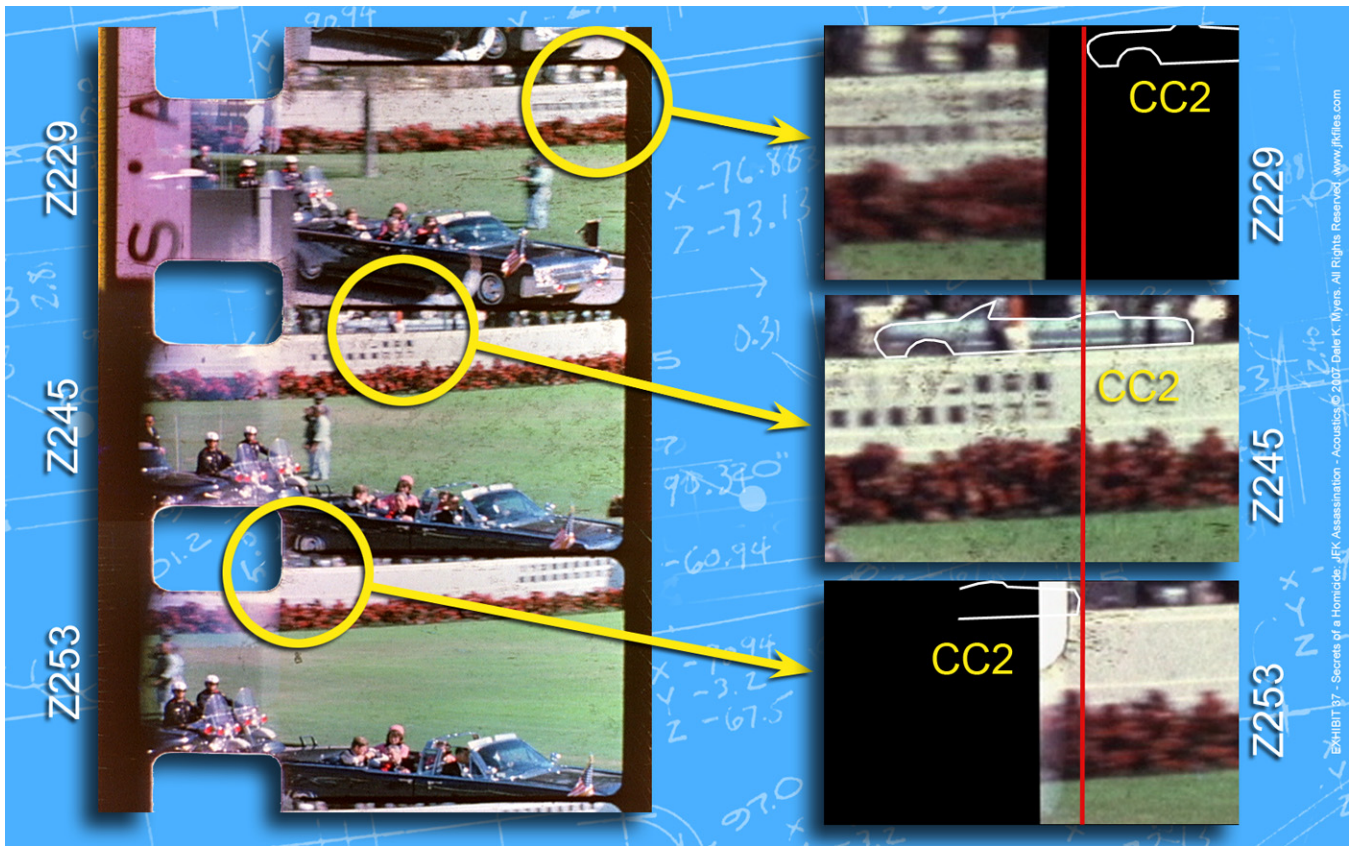


Exhibit 37. Plotting the distance traversed by Camera Car 2 between Zapruder frames Z229 and Z253.

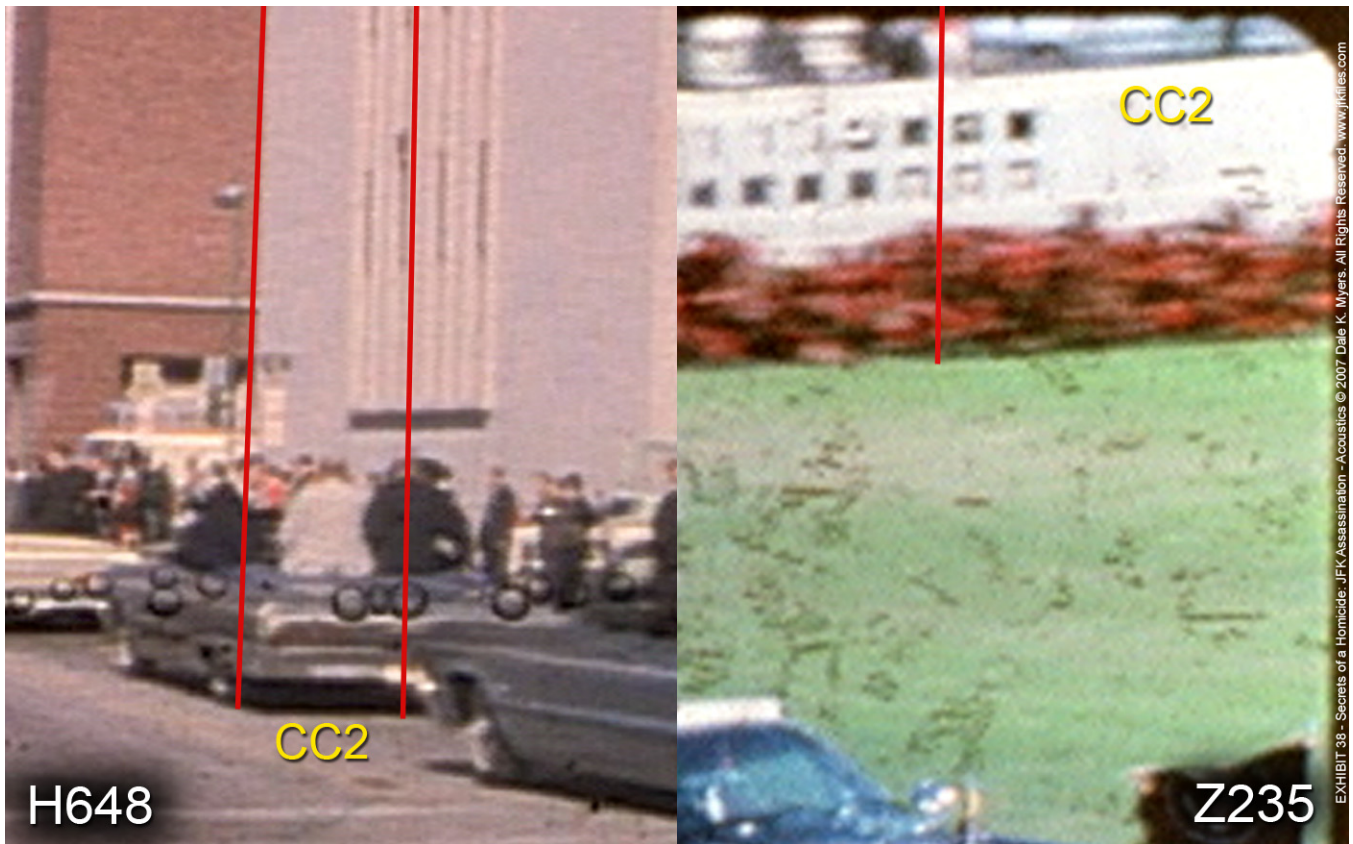


Exhibit 38. Plotting the position of Camera Car 2 at Hughes frame H648 and Zapruder frame Z235.

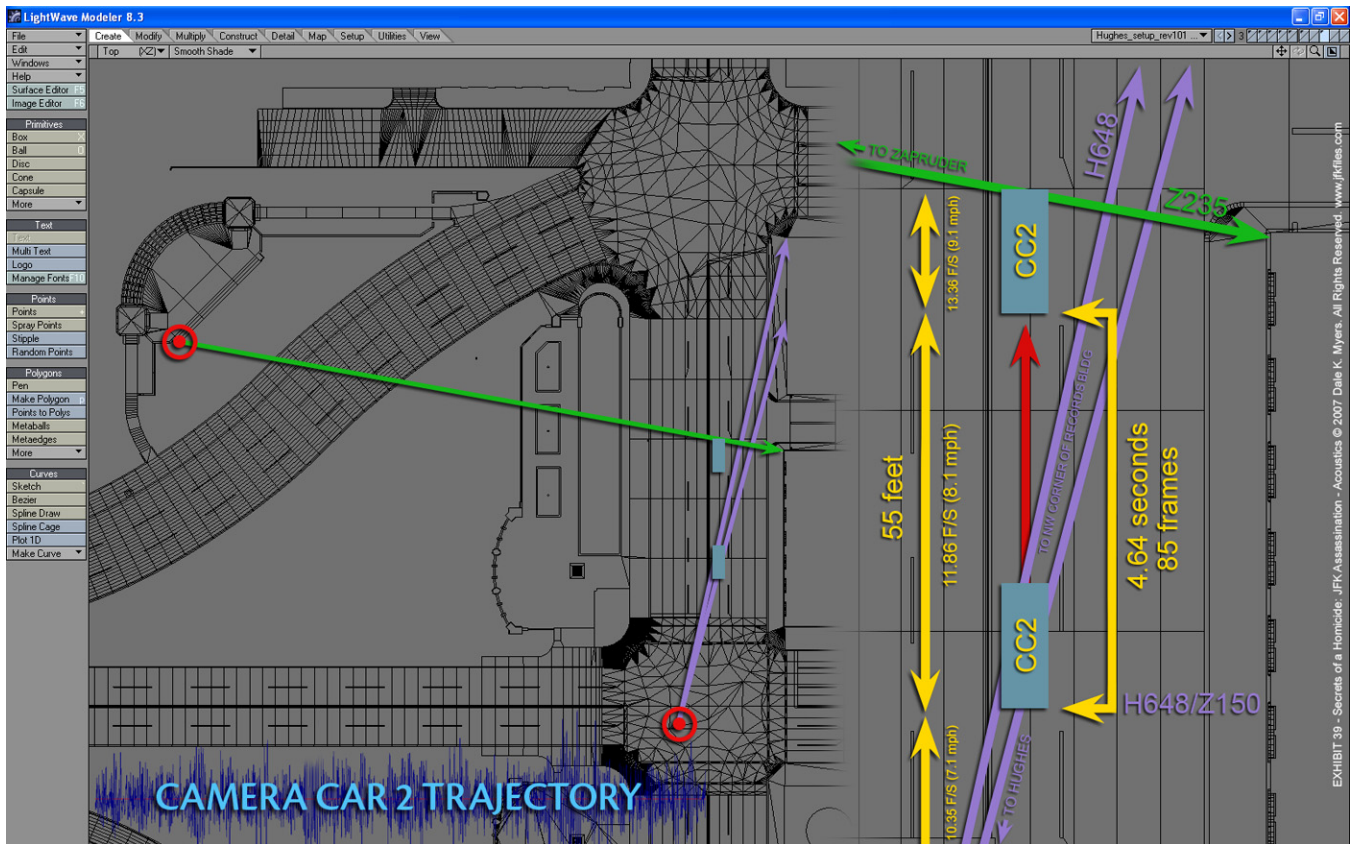


Exhibit 39. Plotting the distance traversed by Camera Car 2 between Hughes H648 and Zapruder Z235.

(SEC-4) The trajectory and speed of the Dallas police officer Marion L. Baker’s motorcycle as depicted in the Robert Hughes and Abraham Zapruder films is consistent with Hughes frame H648 synchronizing to Zapruder frame Z150.

A study of the movements of Dallas police officer Marion L. Baker’s motorcycle was undertaken to determine if those movements were consistent with the hypothesis that Hughes frame H648 was the equivalent of Zapruder frame Z150.

For a complete description of the Robert Hughes film, the camera running speed, and method of resolving Hughes’ position, see SEC-2, pp.60-61.

A virtual camera matching the position and field-of-view of the Hughes camera was placed into a computer model of Dealey Plaza. [See SEC-2, pp.60-61, for the complete methodology.] A second virtual camera, matching Zapruder’s field-of-view, was also added to the computer model.

Using the Hughes and Zapruder films, as well as measurements obtained from a computer model of Dealey Plaza, it was possible to triangulate the trajectory and speed of Dallas police officer Marion L. Baker’s motorcycle, and thus, synchronize the two films. The results show that:

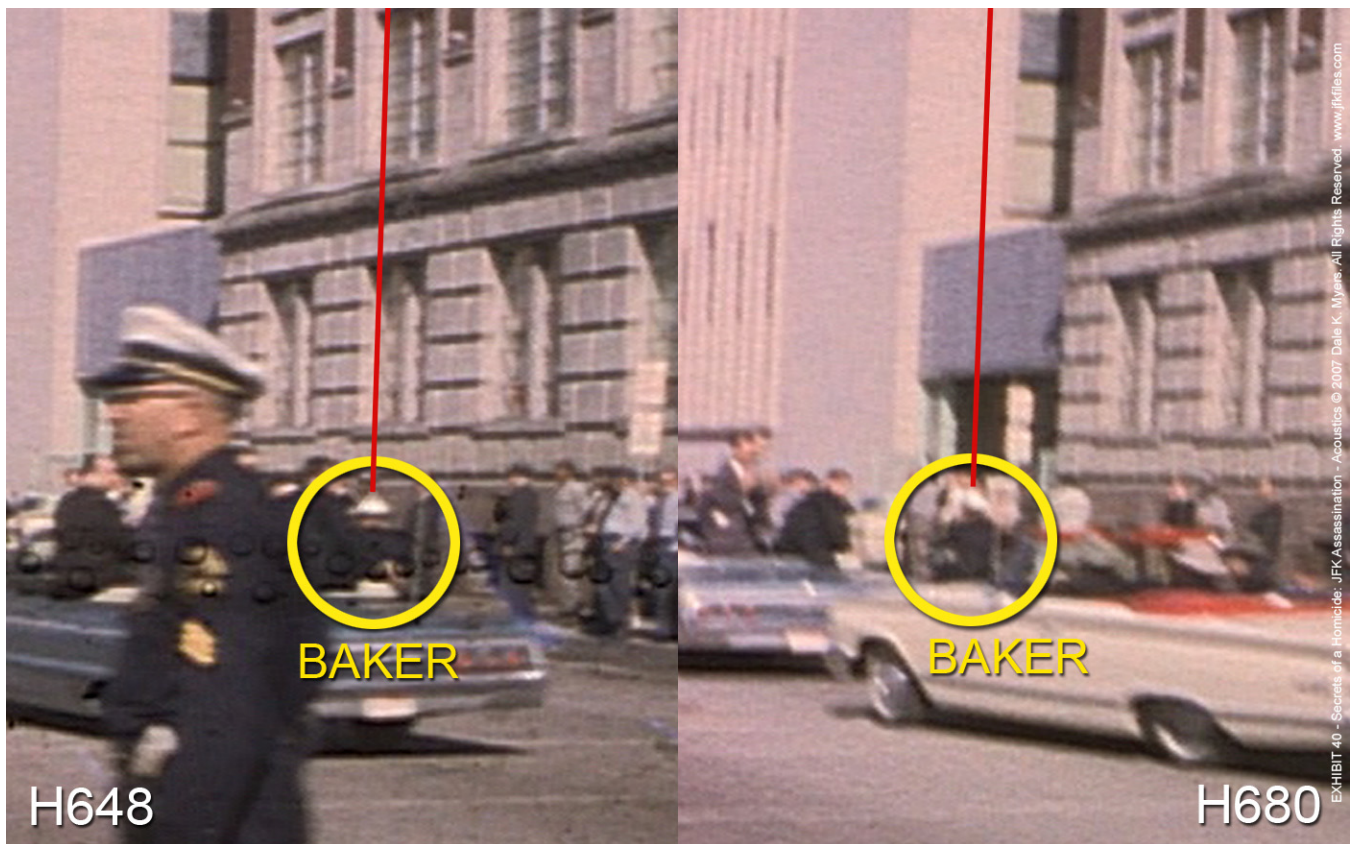


Exhibit 40. Plotting the position of M.L. Baker at Hughes frames H648 and H680.

(a) Dallas police officer Marion L. Baker's motorcycle speed between Hughes frames H648-H680 was calculated to be 10.26 feet/second (7.0 mph).

A computer model of Officer Baker's motorcycle was positioned to match Hughes frame H648 by noting the motorcycle's relationship to a line-of-sight drawn between Hughes' camera and the windows on the west wall of the Dallas County Courthouse building. A computer model of the motorcycle was also positioned to match Hughes frame H680 by noting the motorcycle's relationship to a line-of-sight drawn between Hughes' camera and the opening at the side entrance to the county jail (located between the Records and County Courthouse buildings). ^[Exhibit 40] The distance between these two positions (Hughes frames H648-H680) was measured at 19.5 feet. Baker traversed this distance over the course of 35 frames.¹²⁴ Dividing the speed of the Hughes camera (18.3 frames/second) into the frame count yields a time of 1.9 seconds. This calculates to a speed of 10.26 feet/second (7.0 mph). ^[Exhibit 41]

(b) Dallas police officer Marion L. Baker's motorcycle speed between Zapruder frames Z241-Z255 was calculated to be 12.7 feet/second (8.7 mph).

124. The total frame count includes 3 frames missing at the point of a film splice between Hughes frames H648-H649.

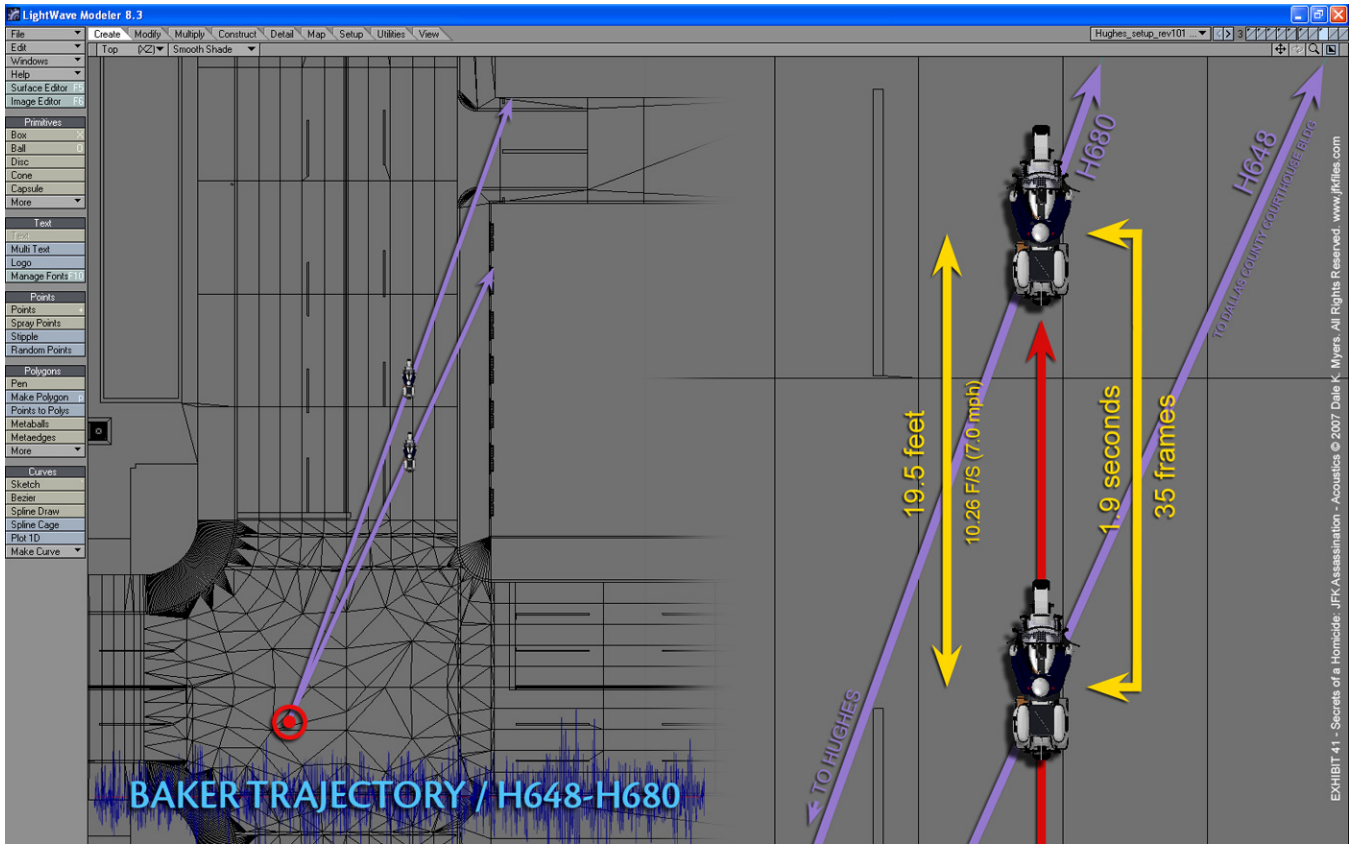


Exhibit 41. Plotting the distance traversed by M.L. Baker between Hughes frames H648 and H680.

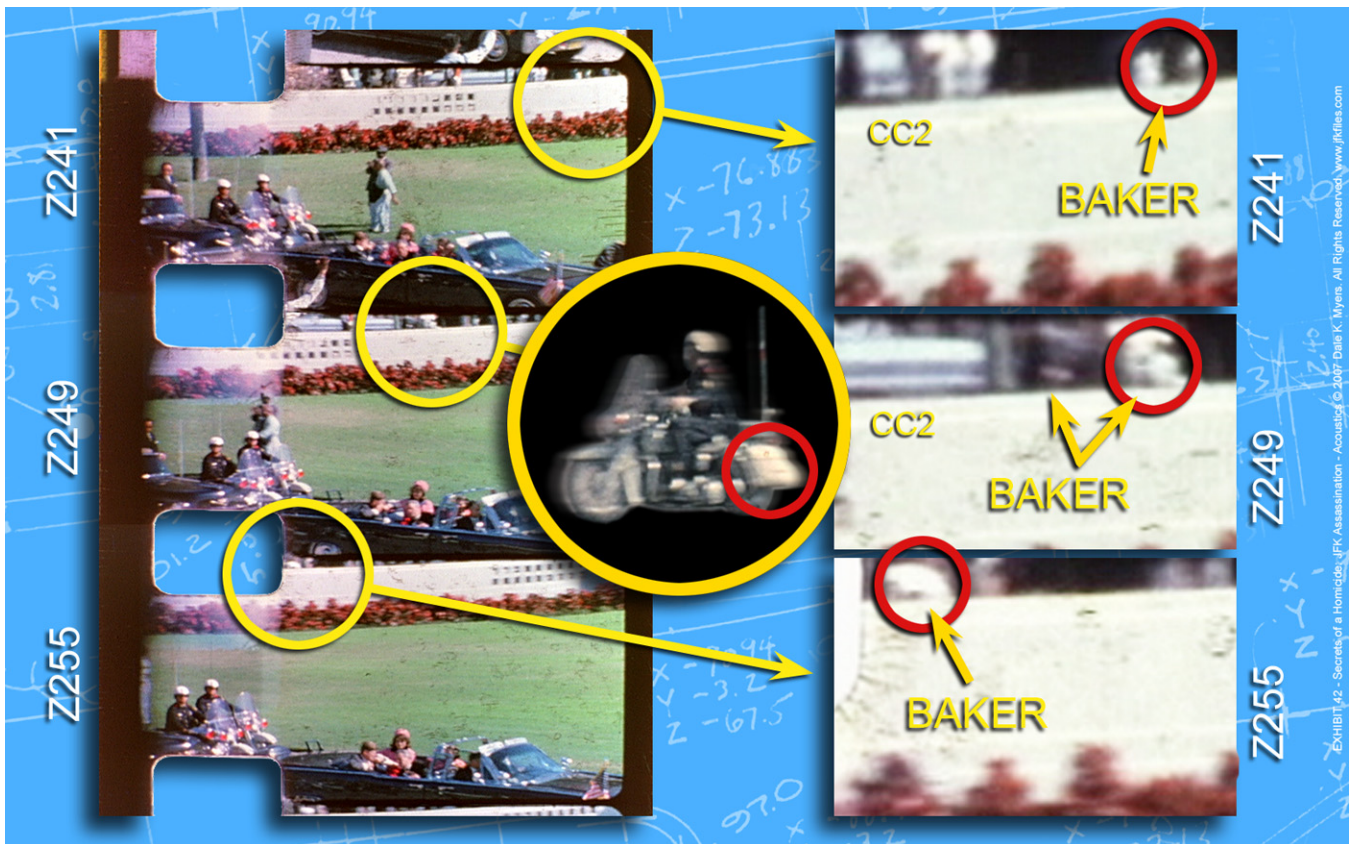


Exhibit 42. Plotting the distance traversed by M.L. Baker between Zapruder frames Z241 and Z255.

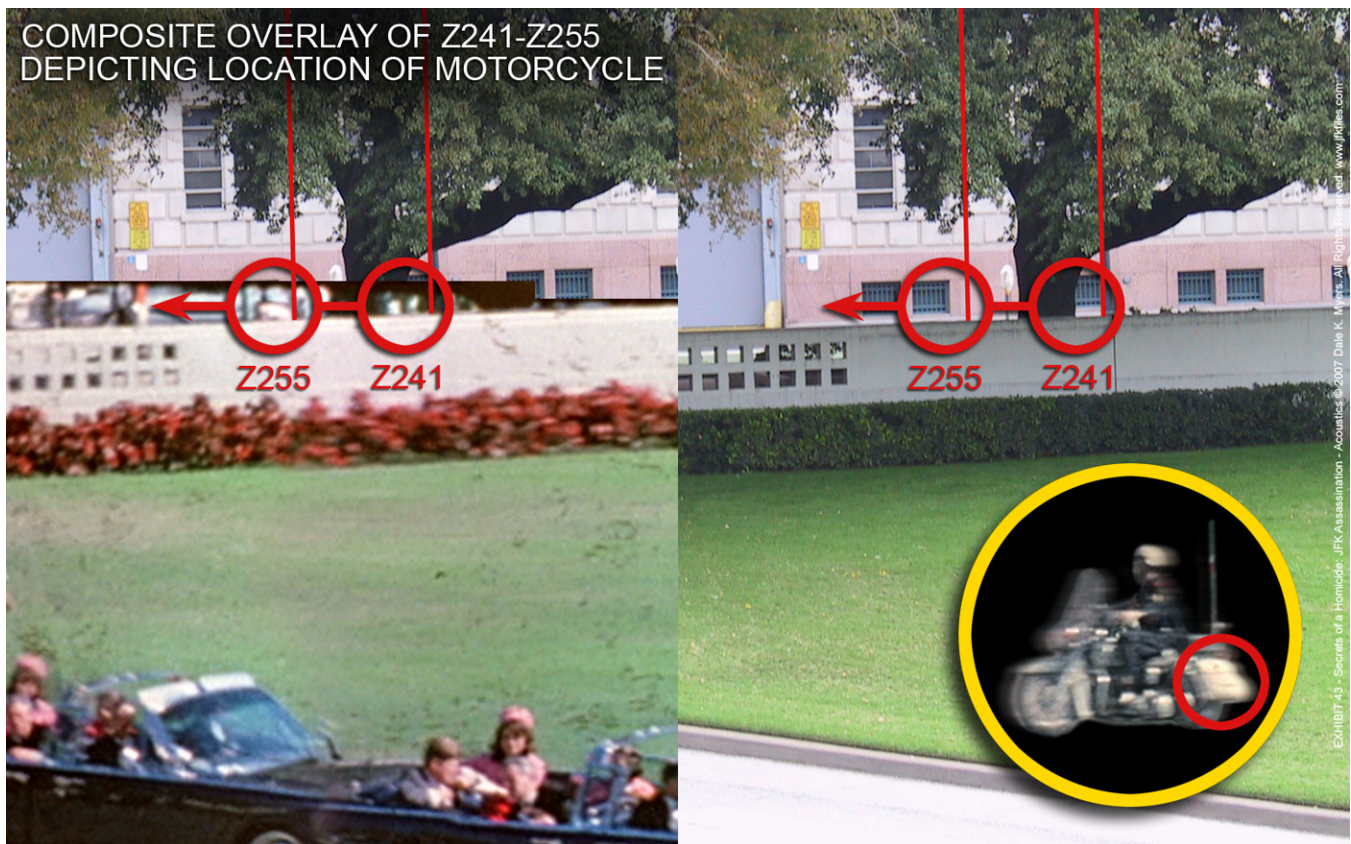


Exhibit 43. Composite image depicting the location of M.L. Baker on Houston Street between Z241 and Z255.

An enlarged and stabilized version of Zapruder frame sequence Z241-255 reveals a motorcycle moving north on Houston Street. [Exhibit 42] The left-rear white saddle bag of the motorcycle is clearly seen trailing Camera Car 2, the eleventh vehicle of the motorcade. The front wheel of the motorcycle is obscured by Camera Car 2, while the engine and rider appear as a soft, black blur. The top portion of the motorcycle, including the rider, is cropped by the top of the film frame.

Computer models of a motorcycle was positioned to match both Zapruder frames Z241 and Z255 by noting the motorcycle's relationship to a line-of-sight drawn between Zapruder's camera and the windows at the base of the west wall of the Dallas County Courthouse building. [Exhibit 43] The distance between these two positions (Zapruder frames Z241-Z255) was measured at 9.78 feet. The motorcycle traversed this distance over the course of 14 frames. Dividing the speed of the Zapruder camera (18.3 frames/second) into the frame count yields a time of 0.77 seconds. This calculates to a speed of 12.7 feet/second (8.7 mph). [Exhibit 44]

Only two motorcycle officers were in the area of Camera Car 2 during the motorcade: Marion L. Baker and H.B. McLain. It is believed that the subject motorcycle was ridden by Officer Baker. There are three reasons for this determination:

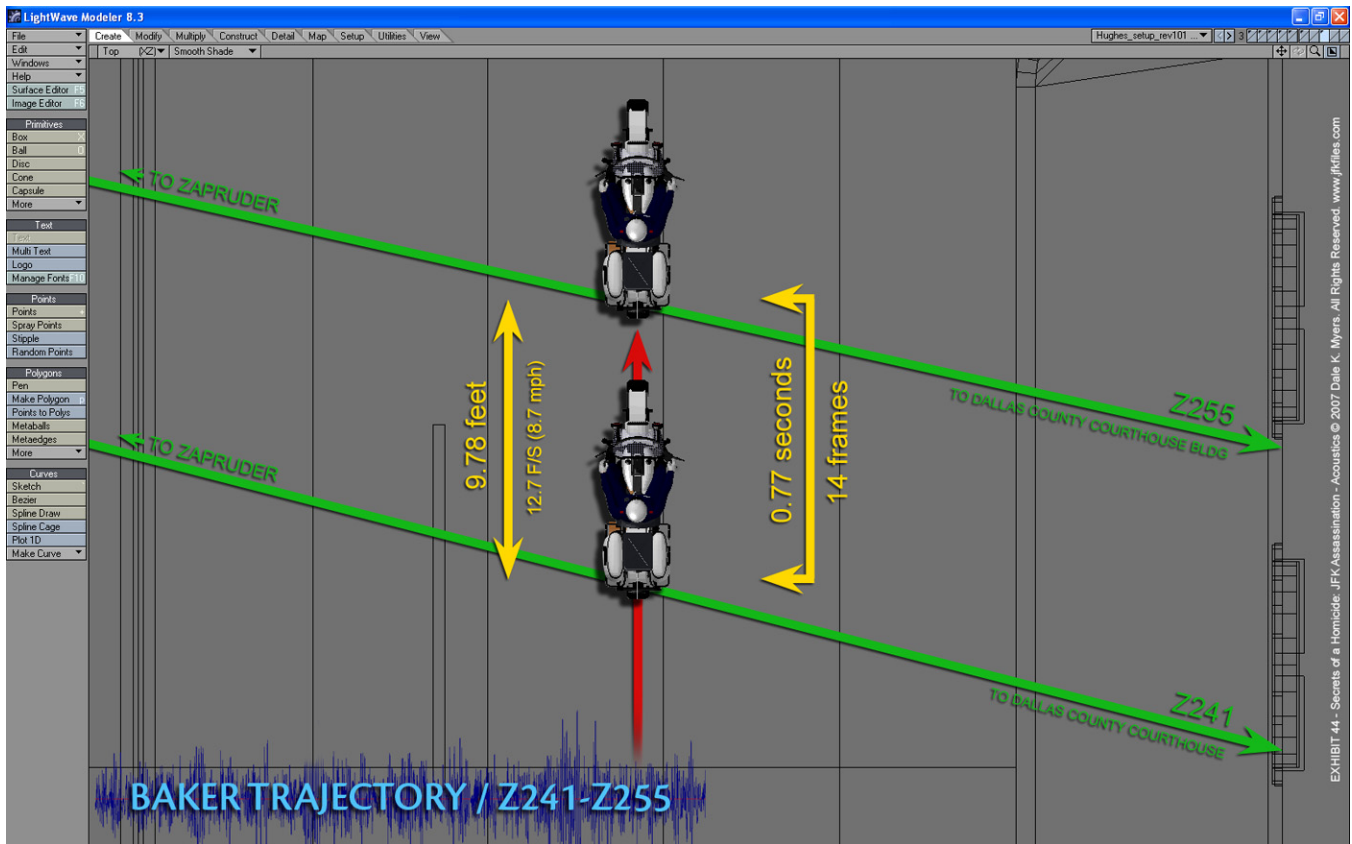


Exhibit 44. Plotting the distance traversed by M.L. Baker between Zapruder frames Z241 and Z255.

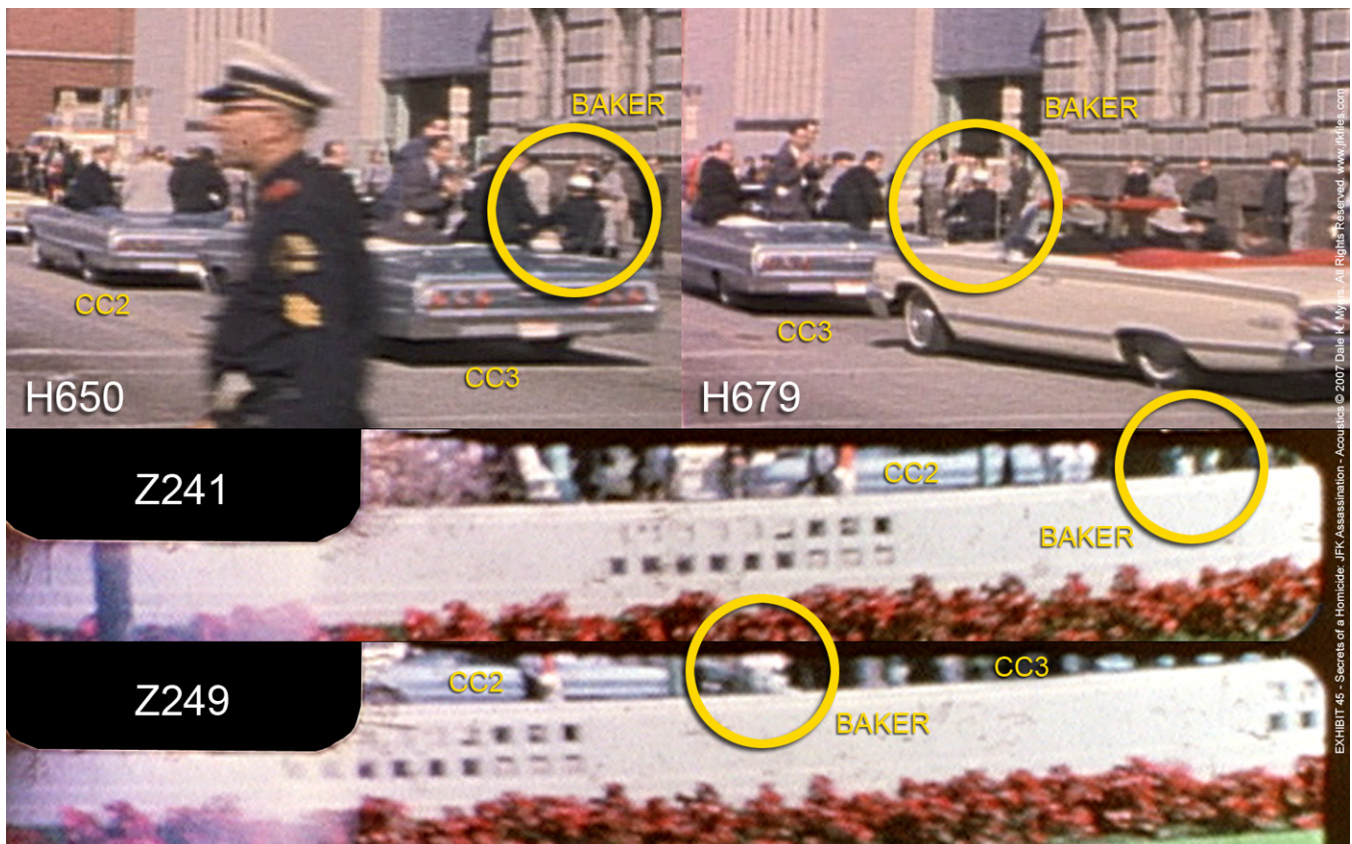


Exhibit 45. Hughes and Zapruder frames depicting M.L. Baker riding between Camera Cars 2 and 3.



Exhibit 46. Stereoscopic image depicting the position of M.L. Baker relative to Camera Cars 2 and 3.

(i) The Hughes film shows Officer Baker in the position of the subject motorcycle.

The Hughes film, which depicts the procession entering Dealey Plaza, shows Baker riding between Camera Car 2 and 3, about one car length ahead of McLain, and in the same position as the subject motorcycle seen in the stabilized Zapruder sequence. ^[Exhibit 45] Baker's position relative to Camera Car 2 and 3 is best seen in a 3D stereo view anaglyph¹²⁵ prepared from two adjoining frames of the Hughes film. ^[Exhibit 46]

(ii) Baker's speed, as seen in the Hughes film, is consistent with the speed of the motorcycle seen in the Zapruder film sequence.

It was determined that Officer Baker was traveling at 7.0 mph between Hughes frames H648-H680. [See (a) above.] A computer-assisted geometric analysis of Zapruder frames Z241-Z255 shows the subject motorcycle traveling at a speed of 8.7 mph. [See (b) above.]

125. Red-Blue stereo glasses (red-left eye, blue-right eye) are required to see the 3D effect.

Both of these speeds are consistent with the increase in speed of the motorcade in general, and Camera Car 2 in particular. For instance, a computer analysis of the movements of Camera Car 2 show it traveling at 7.1 mph between Hughes frames H614-H639, the same relative speed of Officer Baker at that time. In addition, Camera Car 2 was also found to have been moving at 9.1 mph between Z229 and Z253, which also is the same relative speed of the subject motorcycle at that time.

(iii) The trajectory of the subject motorcycle in the Zapruder film sequence is a continuation of Officer Baker's projected path as seen in the Hughes film.

Officer Baker is seen traveling north on Houston Street between Hughes frames H648-H680 at 10.26 feet/second (7.0 mph). [See (a) above] The subject motorcycle is found to traverse Zapruder frames Z241-255 at a speed of 12.7 feet/second (8.7 mph). Geometric analysis shows that the distance between Baker's last known position, as seen in the Hughes film at H680, and the subject motorcycle's position at Zapruder frame Z241 is 35.13 feet. If Baker continues accelerating, from 7.0 mph to 8.7 mph, as he travels north on Houston, he will traverse the 35.13 feet in 3.06 seconds at an average speed of 7.8 mph. [See Exhibit 48, p.75] A computer-assisted geometric analysis of Camera Car 2 shows it traveling at an average speed of 8.1 mph during this period. Both Baker and Camera Car 2's projected speeds are consistent with the conclusion that the subject motorcycle that appears in Zapruder frames Z241-255 is, in fact, Officer Baker.

(c) A computer model of the position of Officer Baker's motorcycle at Hughes frame H680 and Zapruder frame Z241 shows that it traverses a distance of 35.13 feet.

A computer model of Officer Baker's motorcycle was positioned to match Hughes frame H680 by noting the motorcycle's relationship to a line-of-sight drawn between Hughes' camera and the opening at the side entrance to the county jail (located between the Records and County Courthouse buildings). A computer model of the motorcycle was also positioned to match Zapruder frame Z241 by noting the motorcycle's relationship to a line-of-sight drawn between Zapruder's camera and the windows at the base of the west wall of the Dallas County Courthouse building. ^[Exhibit 47] The distance between these two positions was measured at 35.13 feet.

(d) Officer Baker's motorcycle would have traversed the 35.13 feet between Hughes frame H680 and Zapruder frame Z241 in 3.06 seconds traveling at an estimated speed of 11.48 feet/second (7.8 mph).

The estimated speed of Officer Baker's motorcycle between Hughes frame H680 and Zapruder frame Z241 was an average speed calculated from Baker's initial speed on Houston Street of 10.26 feet/second (7.0 mph) [See (a) above.] and his speed between Zapruder frames Z241-Z255 of 12.7 feet/second (8.7 mph). [See (b) above.] Dividing the distance of 35.13 feet by the estimated speed of 11.48 feet/second (7.8 mph) yields a time period of 3.06 seconds.

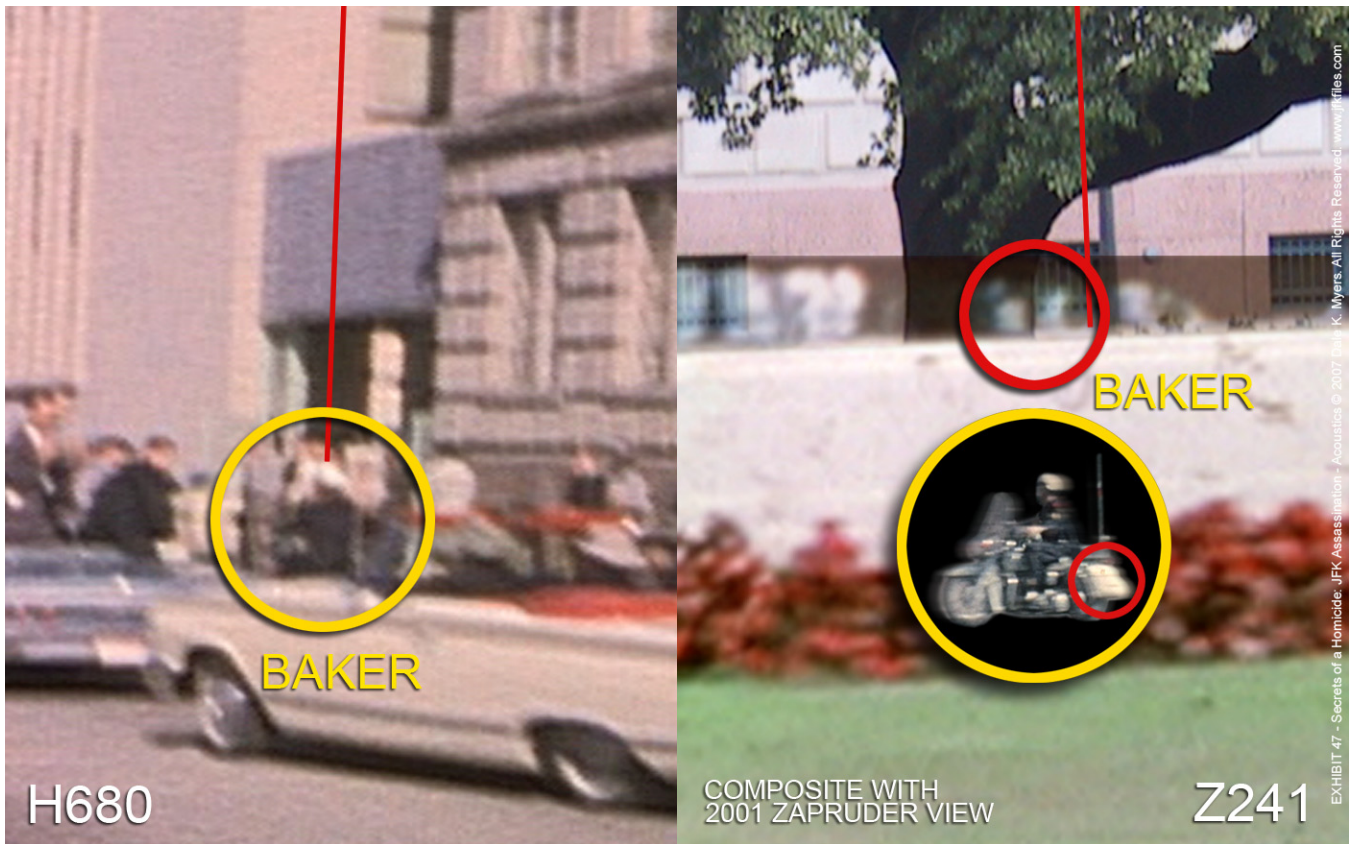


Exhibit 47. Plotting the position of M.L. Baker at Hughes frame H680 and Zapruder frame Z241.

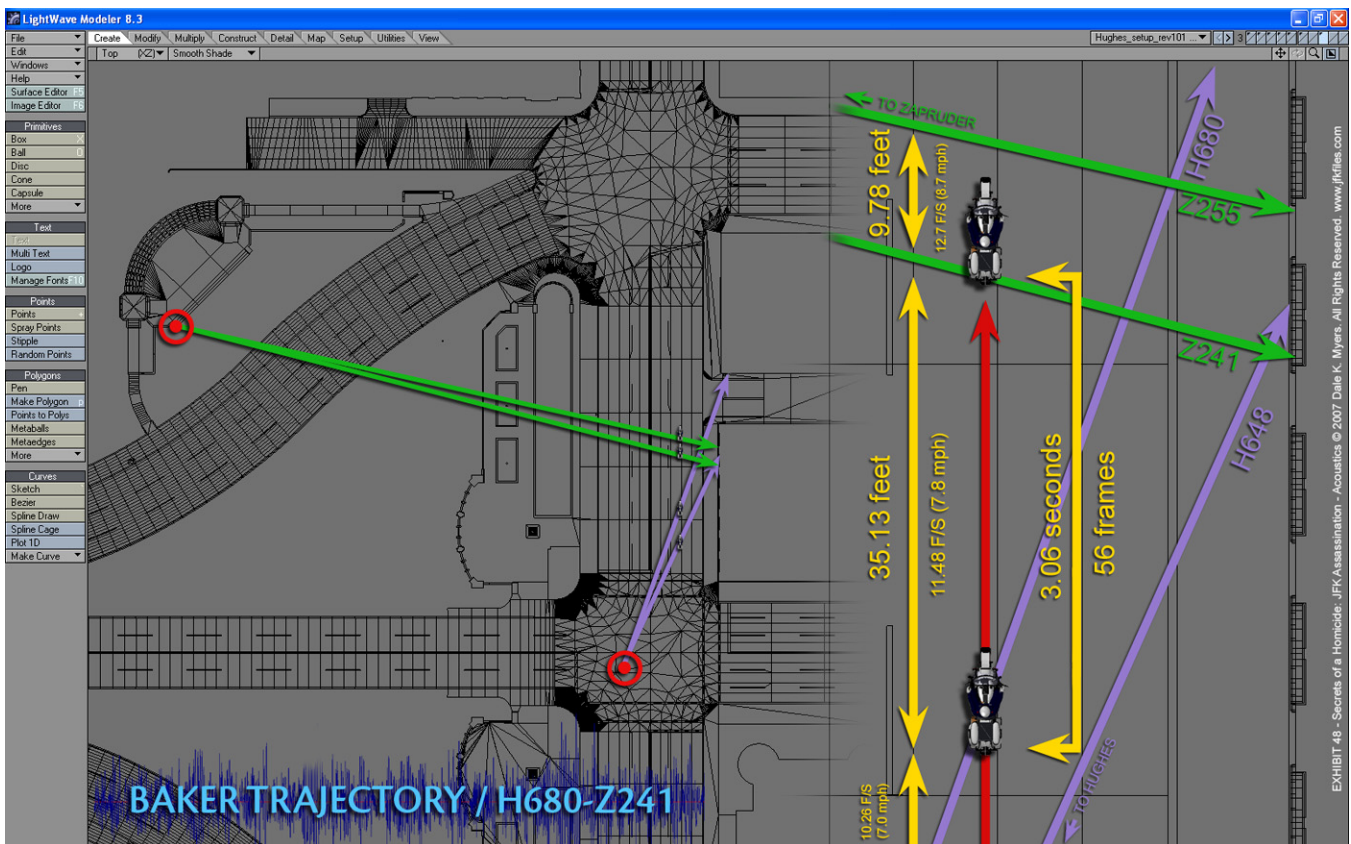


Exhibit 48. Plotting the distance traversed by M.L. Baker between Hughes H680 and Zapruder Z241.

In conclusion, the four calculations above demonstrate that Officer Baker's motorcycle would have traversed the 35.13 foot distance between its known positions at Hughes frame H680 and Zapruder frame Z241 in 3.06 seconds. This time period is equal to 56 Zapruder frames ($3.06 \times 18.3 = 56$). ^[Exhibit 48] Thus, Hughes frame H680 is the equivalent of Zapruder frame Z185. Since, the difference between Hughes frames H648 and H680 is 35 frames (including spliced frames), Hughes frame H648 is the equivalent of Zapruder frame Z150 ($Z185 - 35 = Z150$).

(SEC-5) The trajectory and speed of eyewitness Rosemary Willis as depicted in the Elsie Dorman, Mark Bell, John Martin, and Abraham Zapruder films is consistent with Hughes frame H648 synchronizing to Zapruder frame Z150.

A study of the movements of eyewitness Rosemary Willis was undertaken to determine if those movements were consistent with the hypothesis that Hughes frame H648 is the equivalent of Zapruder frame Z150.

Rosemary Willis, age 10, the youngest daughter of assassination eyewitness Phil Willis, can be seen running alongside the presidential limousine in four amateur films – Elsie Dorman, Mark Bell, John Martin, Jr., and Abraham Zapruder. Ms. Willis is easily identified by a red dress and a white hooded jacket.¹²⁶

A computer model of Dealey Plaza was utilized to track the movements of Rosemary Willis, as depicted in the Dorman, Bell, Martin, and Zapruder films.

The Elsie Dorman film consists of 5 sequences; 3 pre-assassination, 1 during the shooting, and 1 post assassination. Sequence 1 is the first that depicts the presidential limousine, which appears turning from Main onto Houston Street. Sequences 2 and 3 depict the limousine heading north on Houston and making the turn onto Elm Street. Sequence 4 depicts spectators standing on the south side of Elm Street as well as a glimpse of the Vice Presidential car and its Secret Service follow-up car. Sequence 5 depicts a glimpse of Mayor Cabell's car, spectators at the corner of southwest corner of Elm and Houston Streets, and two congressional cars and a motorcycle officer approaching the Houston and Elm Street intersection. The five sequence film contains a total of 496 frames. The third sequence (D192-D335) is the one depicting Rosemary Willis running along the south side of Elm Street and is the focus of this study. The frame rate of the Dorman camera, relative to Zapruder's camera, was determined to be 16.8 frames per second.

The F.M. "Mark" Bell film consists of 14 sequences; 3 pre-assassination and 11 post assassination. The third sequence depicts the presidential limousine passing in front of the

126. Trask, Richard B., *Pictures of the Pain*, Yeoman Press, 1994, p.64

Texas School Book Depository after turning from Houston onto Elm Street, and shows Rosemary Willis running alongside the south side of Elm Street. This sequence was numbered B001 through B060 and is the focus of this study. The frame rate of the Bell camera, relative to Zapruder's camera, was determined to be 19.0 frames per second.

The John Martin, Jr., film, as incorporated into the Dallas Cinema Associates (DCA) film, "President Kennedy's Final Hour," consists of 9 sequences; 6 pre-assassination and 3 post assassination. Sequence 1 depicts the lead motorcycles turning from Main Street onto Houston Street. Sequence 2 and Sequence 3 depicts the lead vehicle driven by Dallas Police Chief Jesse Curry turning from Main onto Houston Street. Sequences 4 and 5 depict the presidential limousine turning off of Main Street and traveling north on Houston Street. Sequence 6 (MN207-MN278), the focus of this study, depicts the presidential limousine passing in front of the Texas School Book Depository, and eyewitness Rosemary Willis running alongside the south side of Elm Street. Sequences 7, 8, and 9 depict events in Dealey Plaza following the assassination. The frame rate of the Martin camera, relative to Zapruder's camera, was determined to be 22.8 frames per second.

During Zapruder frames Z133-Z180, Rosemary Willis can be seen running long the south side of Elm Street. She comes to a stop between Z180-Z200¹²⁷ and disappears into the margins of the film at Z223 as Zapruder pans his camera right. Zapruder frames Z133 to Z142 are the focus of this study.

Through visual inspection it was determined that the third sequence in both the Dorman and Bell films, and the sixth sequence in the Martin film, capture portions of the same period of time from three different angles. All three film sequences depict Rosemary Willis as she runs passed the concrete wall rimming the reflection pool on the south side of Elm Street.

The Zapruder film captures a continuation of Rosemary Willis' progression down Elm Street at a point in time slightly later than that shown in the Dorman/Bell/Martin sequences. Determining how much time passed, if any, between the Dorman/Bell/Martin sequences and the Zapruder sequence, and whether that time period was consistent with Hughes frame H648 synchronizing to Zapruder frame Z150, was the goal of this study.

To begin, four virtual cameras matching the positions and field-of-views of the Dorman, Bell, Martin, and Zapruder cameras were placed into a computer model of Dealey Plaza. [See SEC-2, pp.60-61, for the complete methodology.]

The trajectory and speed of Rosemary Willis as she ran along the south side of Elm Street was determined by triangulating her position at various points along her route using a computer model of Dealey Plaza and the Dorman, Bell, Martin, and Zapruder films as reference. The results show that:

127. Rosemary Willis recalled hearing three shots coming from the direction the Texas School Book Depository, adding, "I stopped when I heard the first shot." (Trask, Richard B., *Pictures of the Pain*, Yeoman Press, 1994, p.65)

(a) Between Dorman/Bell frames D276-B024 and Dorman/Bell frames D308-B060, Rosemary Willis traversed a 20.45 foot distance at an average speed of 9.51 feet/second (6.5 mph).

Projecting lines-of-sight from the Dorman and Bell camera positions through Rosemary Willis' position (as determined from Dorman frames D276, 282, 299, and 308 and Bell frames B024, 031, 050, and 060), [Exhibit 49] allowed her precise location to be plotted on the computer model at the frames specified. It was determined that her path was in the shape of an arc that ran adjacent to the concrete wall rimming the reflection pool. It was also determined that she traversed the 20.45 foot distance between Dorman/Bell frames D276-B024 and D308-B060 at an average speed of 9.51 feet/second (6.5 mph). [Exhibit 50]

(b) Between Zapruder frames Z133 and Z142, Rosemary Willis traversed a 6.29 foot shadowed area at a speed of 12.84 feet/second (8.8 mph).

Visual inspection of a stabilized version of Zapruder frame sequence Z133-Z142 demonstrates that Ms. Willis is seen entering a shadowed area cast by the bush and concrete wall to her left at Zapruder frame Z133, and that by Z142 she begins to exit this same shadowed area. [Exhibit 51] The subject shadowed area also appears in the Dorman film. Multiple Dorman

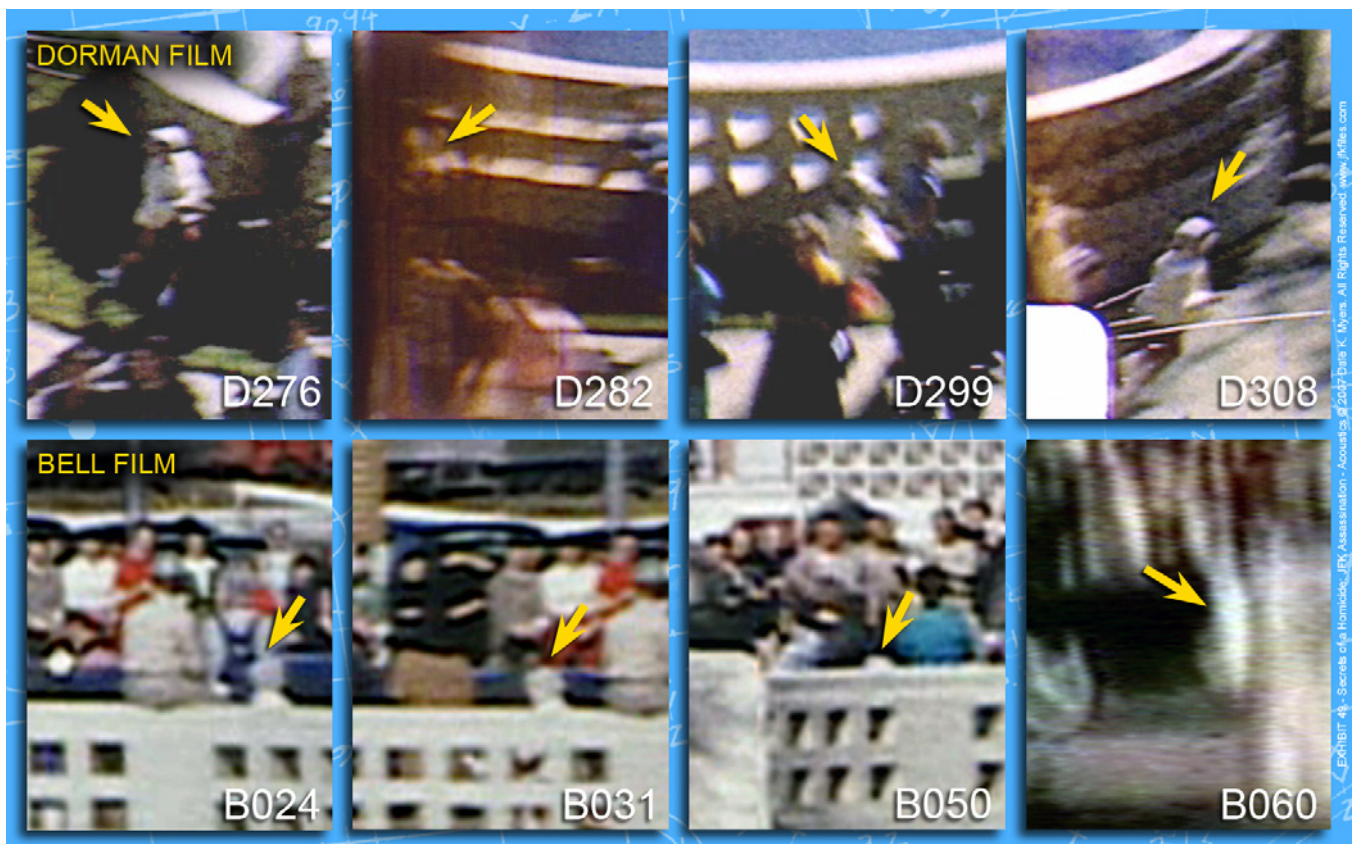


Exhibit 49. Plotting the position of Rosemary Willis as depicted in the Dorman and Bell films.

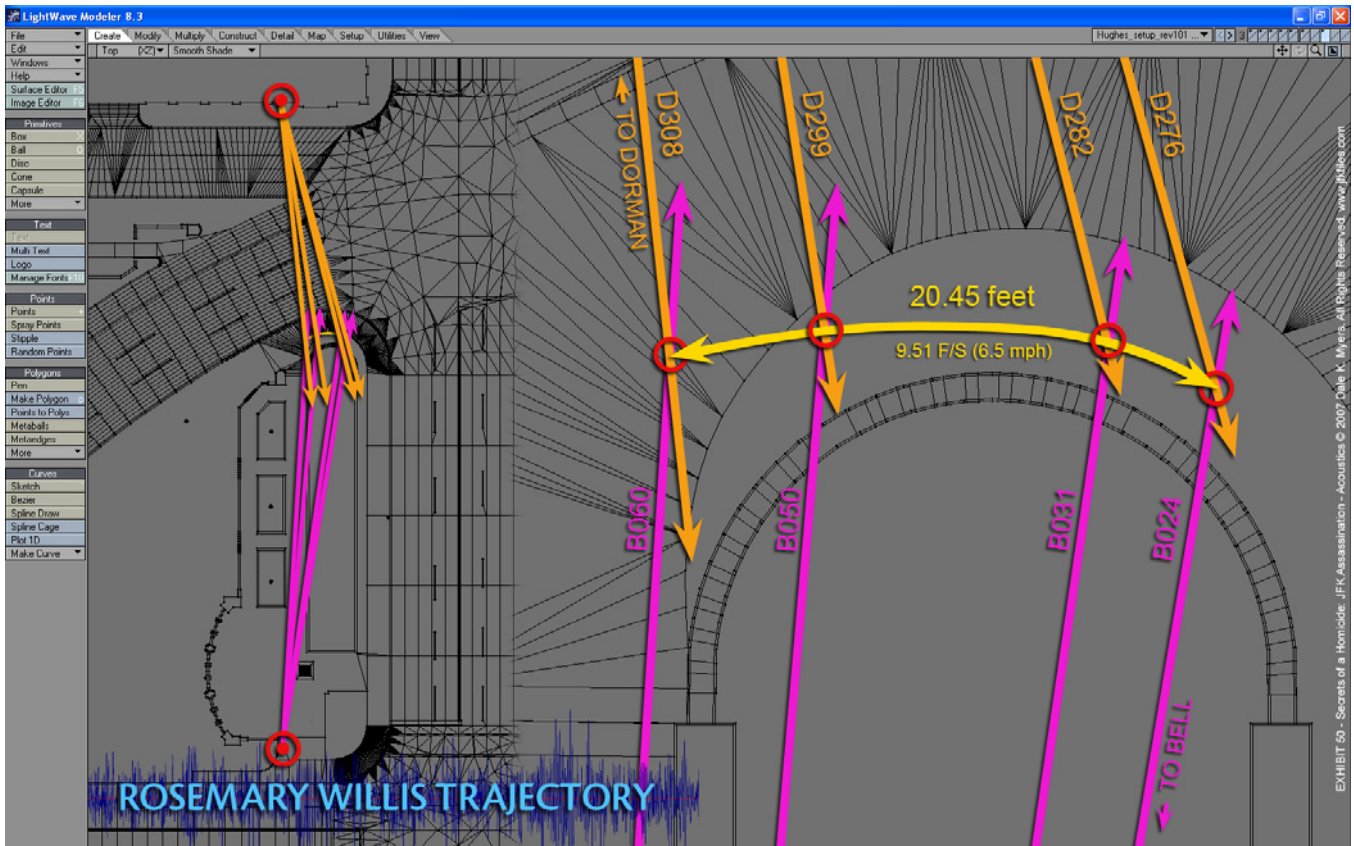


Exhibit 50. Plotting the distance traversed by Rosemary Willis as depicted in the Dorman and Bell films.

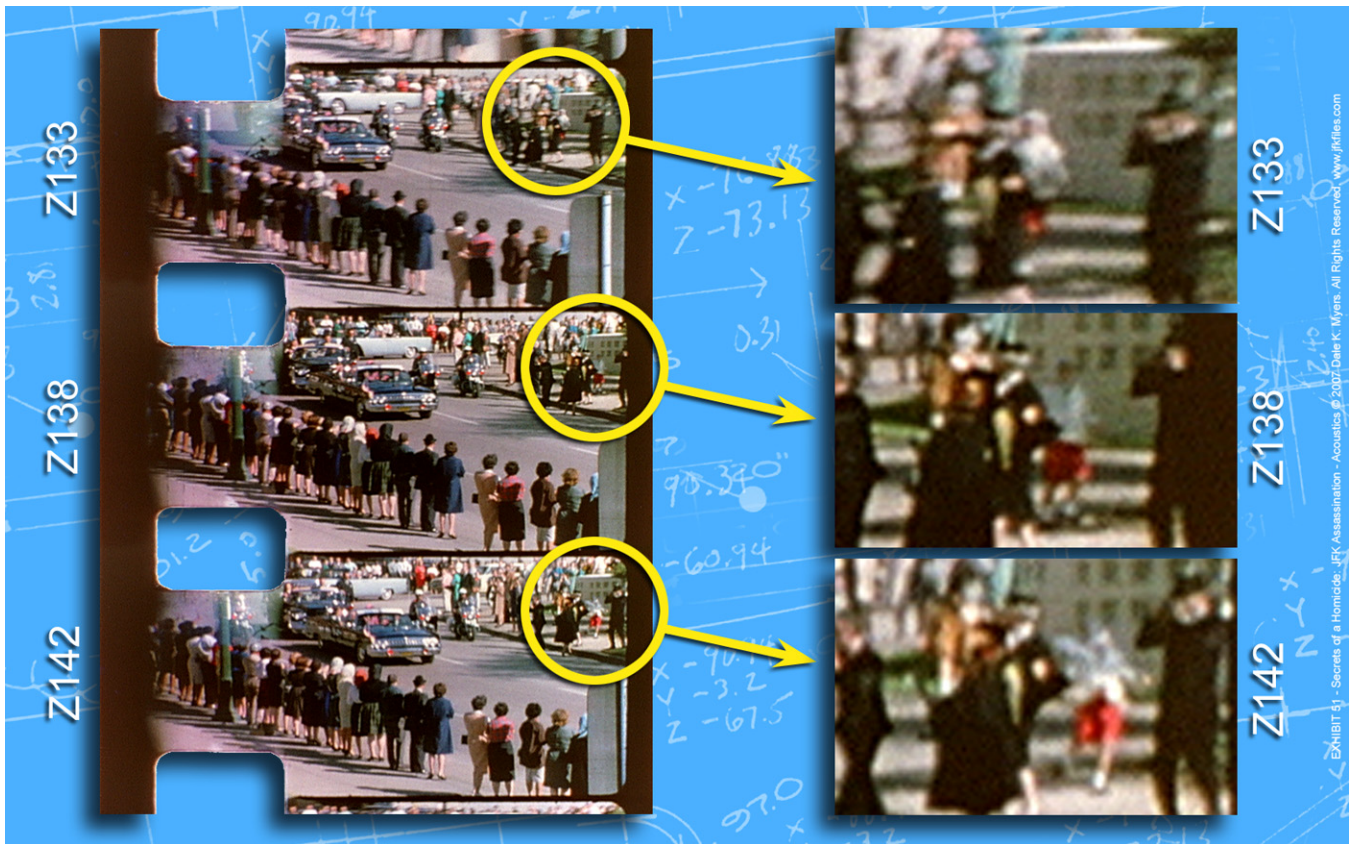


Exhibit 51. Plotting the position of Rosemary Willis between Zapruder frames Z133 and Z142.



Exhibit 52. Mosaic image created from Dorman frames depicting shadow areas along south curb of Elm Street.

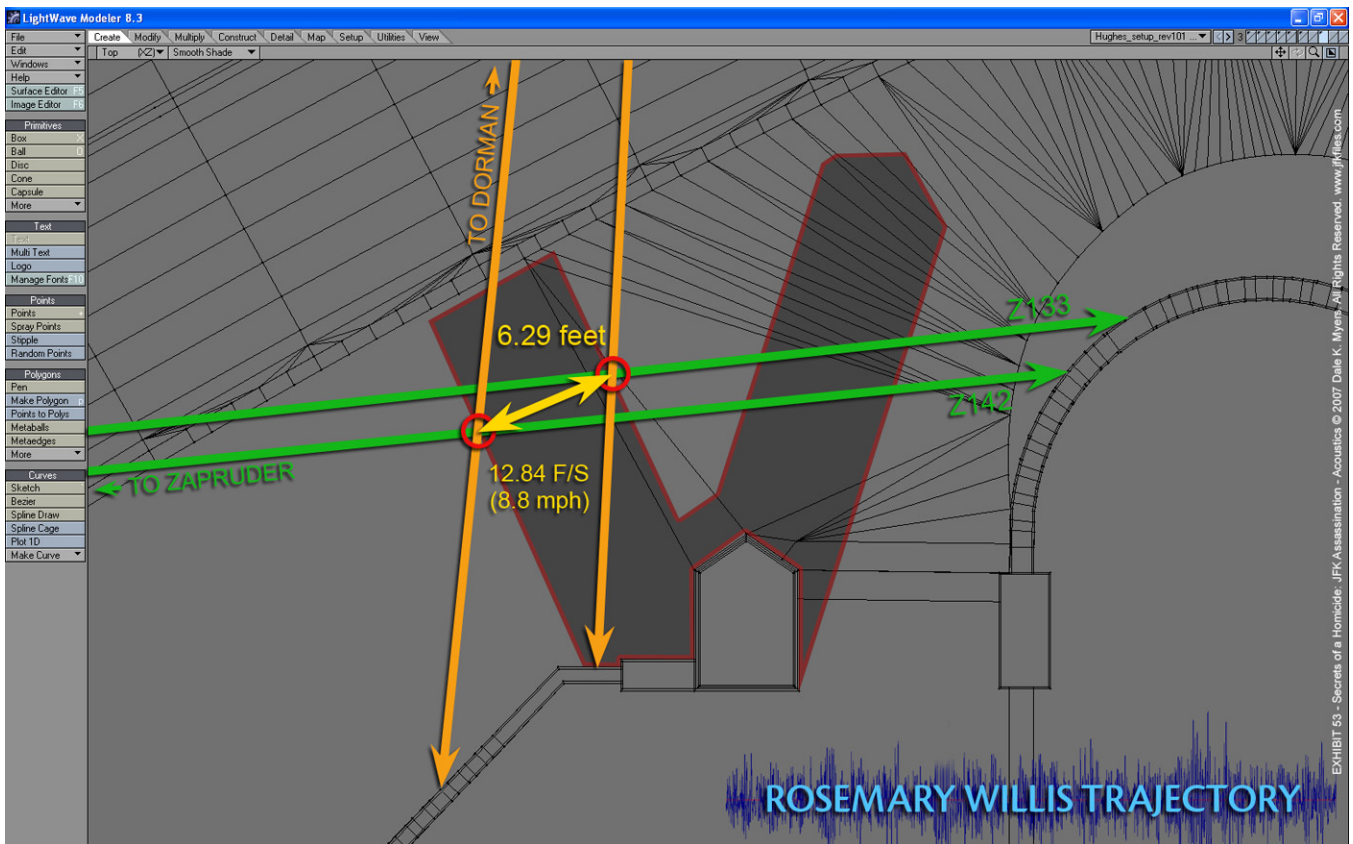


Exhibit 53. Plotting the distance traversed by Rosemary Willis between Zapruder frames Z133 and Z142.

frames were used to create a mosaic image, which illustrated the precise location of the shadowed area. [Exhibit 52] Using the Dorman camera position, this mosaic image was then projected onto the computer model of Dealey Plaza producing a three dimensional outline of the shadowed area. The computer model shows this shadowed area to be 6.29 feet in width. Dividing the width of the shadow (6.29 feet) by the time period Rosemary Willis took to traverse it (0.49 seconds) shows her speed between Zapruder frames Z133-Z142 to be 12.84 feet/second (8.8 mph). [Exhibit 53]

(c) Rosemary Willis' speed between Dorman/Bell frames D308-B060 and Zapruder frame Z133 was determined to be 10.86 feet/second (7.4 mph).

This speed was determined by examining the John Martin, Jr., film which captures the moment in question. Martin's camera position was determined by plotting Martin's field-of-view on a computer model of Dealey Plaza. [Exhibit 54] The camera position was found to be just east of the reflecting pool approximately 139.8 feet north of the north Main Street curb line.

Martin frame MN229 was found to be the equivalent of Dorman/Bell frames D308-B060 – all three frames depicting Rosemary Willis in the same position in front of the concrete retaining wall. This was determined by plotting a line-of-sight from Martin's camera through Ms. Willis'

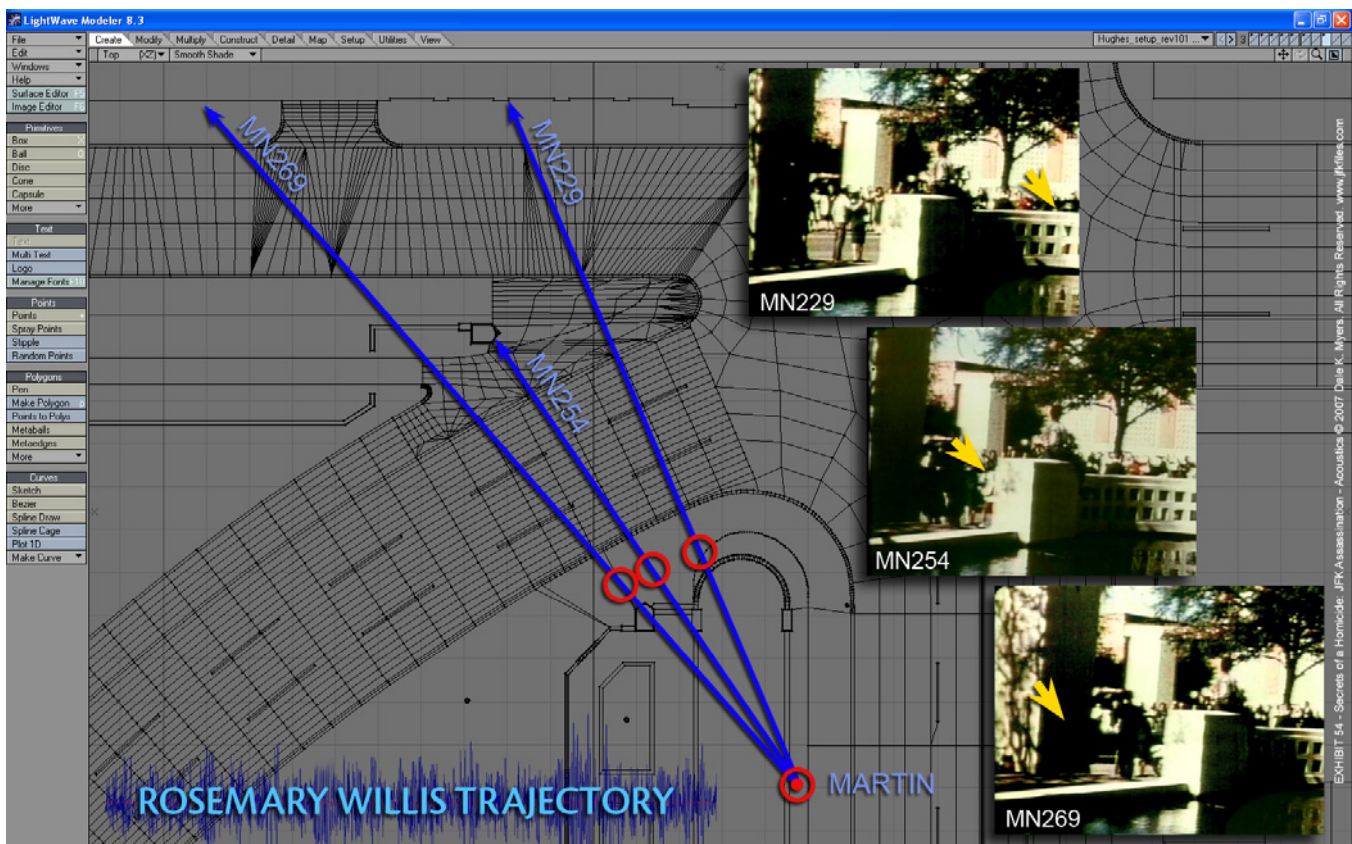


Exhibit 54. Plotting the location of Rosemary Willis between Martin frames MN231 and MN264.

position at Dorman/Bell D308-B060 [See, SEC-5 (a), p.78] and extending that line north until it intersected the south wall of the Texas School Book Depository. The frame at which Ms. Willis passed through this plotted line-of-sight was Martin frame MN229. This synchronization demonstrates that sequence six of the Martin film slightly overlaps the beginning of the Zapruder film; ending at the equivalent of Zapruder frame Z140.

Martin film frame MN269 was found to be the equivalent of Zapruder frame Z133 – which depicts Rosemary Willis entering the shadowed area cast by the bush and concrete wall to her left. This was determined by plotting a second line-of-sight from Martin's camera through Ms. Willis' position at Zapruder frame Z133. [See, SEC-5 (b), p.78] The frame at which Ms. Willis passed through this plotted line-of-sight was Martin frame MN269.

Dividing the distance between Dorman/Bell/Martin D308-B060-MN229 and Zapruder/Martin Z133-MN269 (19.0 feet) by the time required to traverse this distance (1.75 seconds), as depicted in Martin MN229 to MN269, results in a trajectory speed of 10.86 feet/sec (7.4 mph).

This is consistent with an estimated speed which can be deduced without the benefit of the Martin film by averaging Ms. Willis' known speed at Dorman/Bell D308-B060 (6.5 mph) and her known speed at Zapruder frames Z133-Z142 (8.8 mph). The result is an average speed of 11.18 feet/second (7.6 mph).

(d) Rosemary Willis traversed the 19.0 foot distance between her last known position at Dorman/Bell/Martin D308-B060-MN229 and her position at Zapruder/Martin Z133-MN269 in approximately 1.75 seconds; consistent with the hypothesis that Hughes frame H648 is the equivalent of Zapruder frame Z150.

The computer model shows the distance between Ms. Willis' last cross-plotted position (Dorman/Bell/Martin frames D308-B060-MN229) and the shadowed area she enters at Zapruder/Martin frame Z133-MN269 to be 19.0 feet. At the estimated speed of 10.86 feet/second (7.4 mph), Rosemary Willis would have traversed the 19.0 foot distance in 1.75 seconds; a figure consistent with the independent synchronization of the Dorman, Bell, Towner, and Zapruder films. ^[Exhibit 55]

The analysis of Rosemary Willis' movements demonstrates that the Dorman, Bell, and Martin cameras were running concurrently during the time the presidential limousine passed in front of the Texas School Book Depository. All three films capture Rosemary Willis as she ran alongside the limousine. A fourth film – the Towner film – depicts the limousine itself during this same period.

The synchronization of the Hughes, Dorman, Towner, Bell, and Martin films to the Zapruder film demonstrates that these five films capture the motorcade's progression during the period

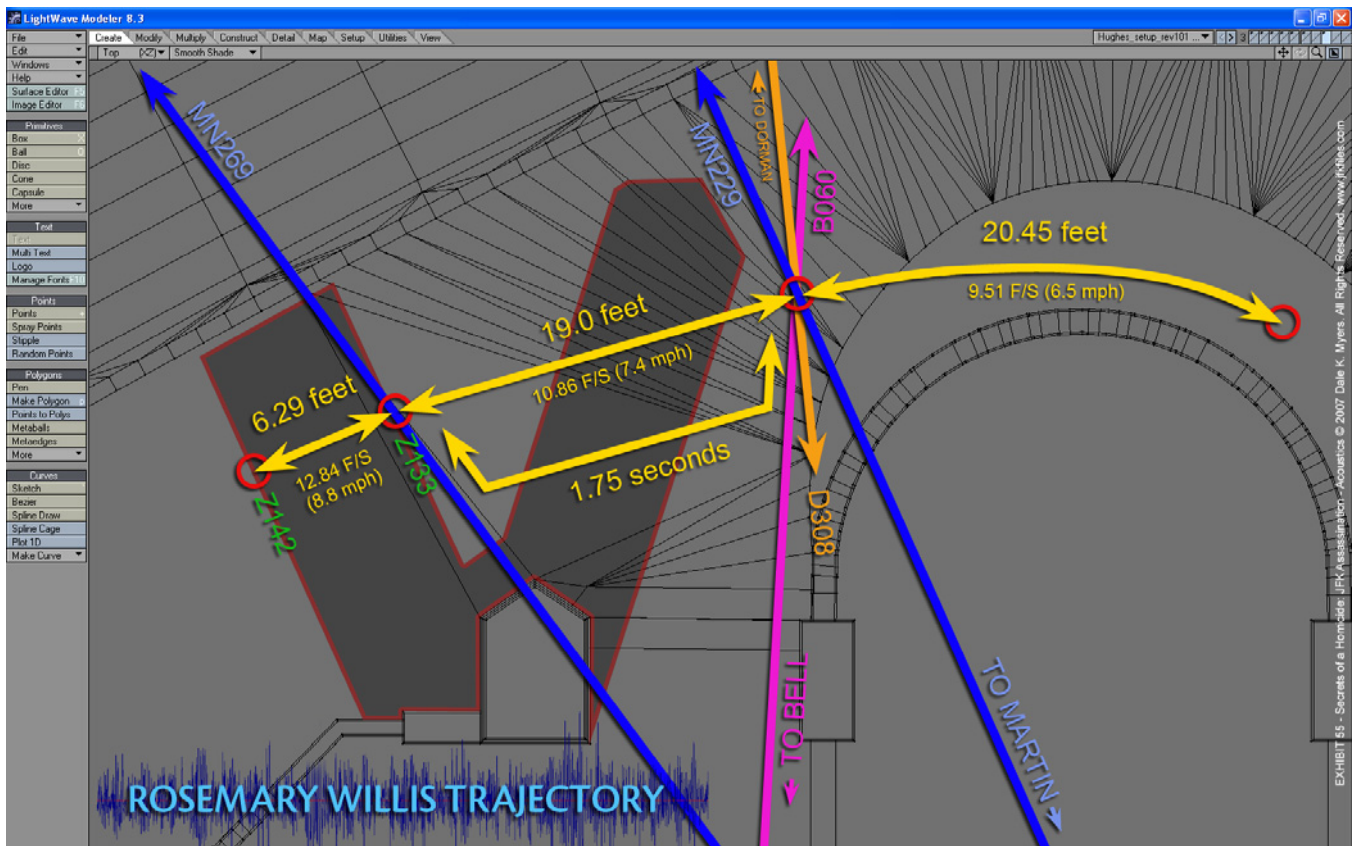


Exhibit 55. Plotting the distance traversed by Rosemary Willis between Martin frames MN229 and MN269.

3.64 to 1.74 seconds prior to the exposure of Zapruder frame Z133. [See *Appendix III*, Amateur Film Synchronization Timeline]

As shown above, Martin frames MN229-MN269 depict Rosemary Willis traversing the 19.0 foot distance between Martin frame MN229 and Zapruder frame Z133 in 1.75 seconds at a speed of 10.86 feet/sec (7.4 mph). This is consistent with the independent synchronization of the Hughes, Dorman, Towner, Bell and Zapruder films.

Thus, the movements of Ms. Willis, as seen in Martin frames MN229-MN269 and Zapruder frames Z133-Z142 (her gait is 5 to 6 frames apart at MN256, 262, 267 and Z133, 136, 142), prove to be a continuation of her movements as depicted in Dorman/Bell frames D276-B024 to D308-B060; and further demonstrate the validity of the synchronization of Hughes frame H648 to Zapruder frame Z150.

APPENDIX II

REBUTTAL OF THE HSCA'S PHOTOGRAPHIC EVIDENCE OFFERED IN SUPPORT OF THE COMMITTEE'S ACOUSTIC EVIDENCE OF CONSPIRACY

On September 11, 1978, Dr. James E. Barger told the HSCA in public hearings that the acoustic tests were designed “to see if [the Dallas police tape] was statistically likely to have contained the sounds of gunfire,”¹²⁸ and that the results he obtained were “a potential corroborating force toward other evidence.”¹²⁹ In essence, it was up to the HSCA to find additional evidence that either confirmed or refuted the acoustic tests which predicted that a motorcycle with an open microphone was transmitting the sounds of gunfire from a location 120 feet (plus or minus 9 feet) behind the President's limousine.¹³⁰

On December 29, 1978, just 5 days before the HSCA's investigation was scheduled to expire, the committee met for one final day of televised public hearings. It was during this public session that the HSCA first offered photographic evidence to support the validity of their acoustic evidence of conspiracy.

In his opening remarks, HSCA Chief Counsel G. Robert Blakey stressed the importance of verifying Barger's work photographically, “If it could be proved that no motorcycle was in the predicted location at the time of the shots, then serious doubt would be raised about the reliability of the acoustics project.”¹³¹ What Blakey should have said, of course, was that the acoustics evidence would be *destroyed* by such proof. Barger said as much in a 2001 email exchange, writing, “...if it can be shown that there was no vehicle or person with a police radio near the trajectory where I found it to be, then, that is impeaching evidence.”¹³²

The HSCA presented evidence that only one motorcycle officer was in a position to transmit the sounds of the shooting – Officer H.B. McLain. It was McLain, they concluded, who transmitted the sounds of “gunfire” from a location approximately 120 feet behind the President's limousine. In their final report, the HSCA offered three amateur film sequences to support their conclusions.

128. 2HSCA100

129. 2HSCA94

130. 2HSCA65-69, 81 [Note: In a 2001 email exchange, Barger wrote, “At the time I presented my findings, several Congressmen asked me how they were to interpret my results – since I presented them in probabilistic form. I told them that it was up to them to look for corroborating or impeaching independent (of my analysis) evidence. I mentioned several kinds of independent evidence that would corroborate my findings. One of these was, of course, whether they could find a vehicle or person with a police radio near where I had found it.” (Email group posting from James Barger, April, 2001)]

131. 5HSCA616

132. Email group posting from James Barger, April, 2001

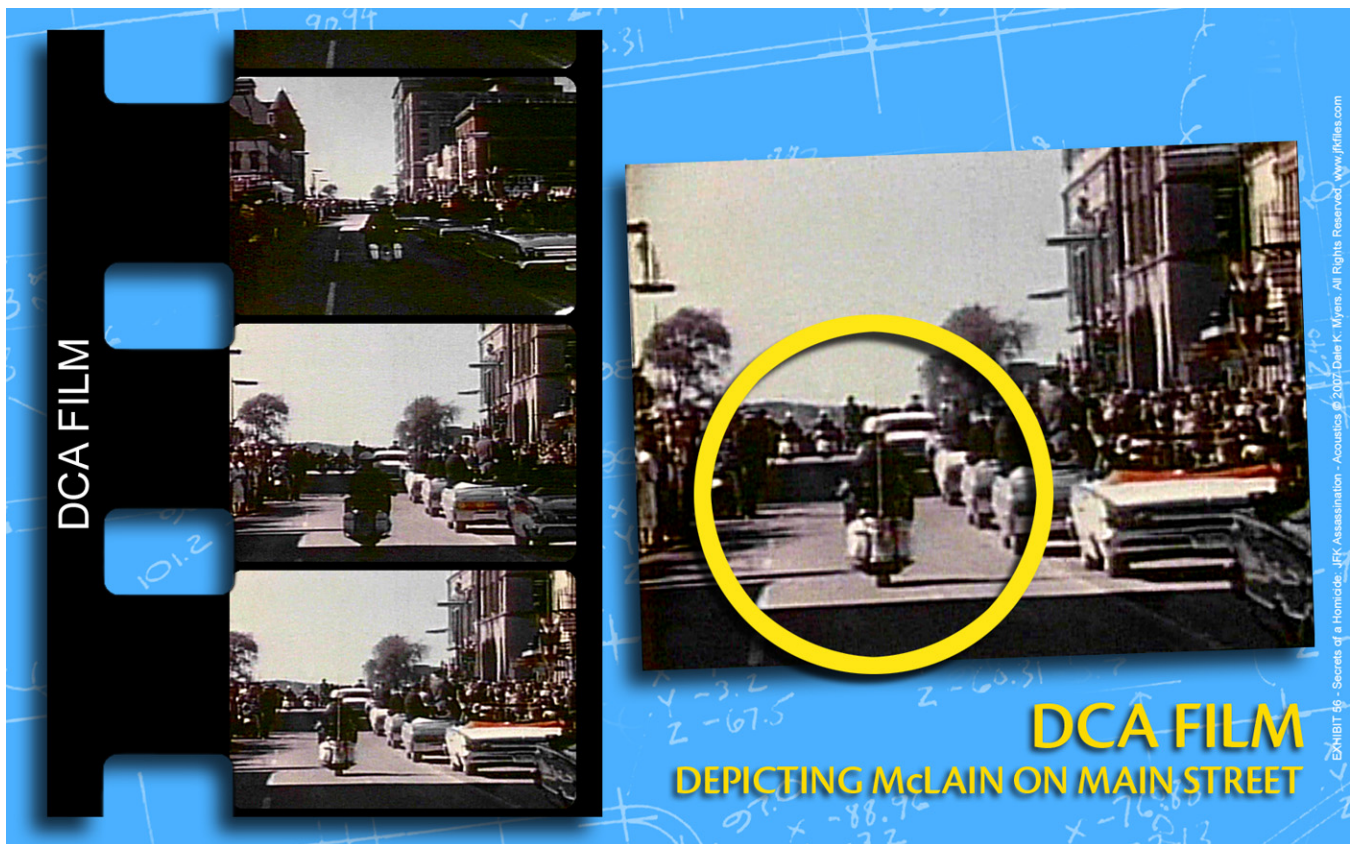


Exhibit 56. H.B. McLain on Main Street as depicted in the Dallas Cinema Associates (DCA) film.

The DCA Film

One sequence, from the Dallas Cinema Associates (DCA) film “President Kennedy’s Final Hour,” shows McLain traveling on Main Street a few blocks before reaching Dealey Plaza and merely establishes that McLain was riding approximately 200 feet behind the President’s limousine about one minute before the shooting.¹³³ [Exhibit 56]

The Hughes Film

The second sequence, from an amateur film by Robert Hughes, shows McLain turning onto Houston Street shortly after the presidential limousine had turned onto Elm Street, one block ahead of McLain.¹³⁴ [Exhibit 57] According to the HSCA, the Hughes film showed McLain riding “several car lengths behind the Presidential limousine as it turned in front of the

133. 5HSCA626 JFK Exhibit F-668

134. 5HSCA626-27 JFK Exhibit F-669-71; 8HSCA102

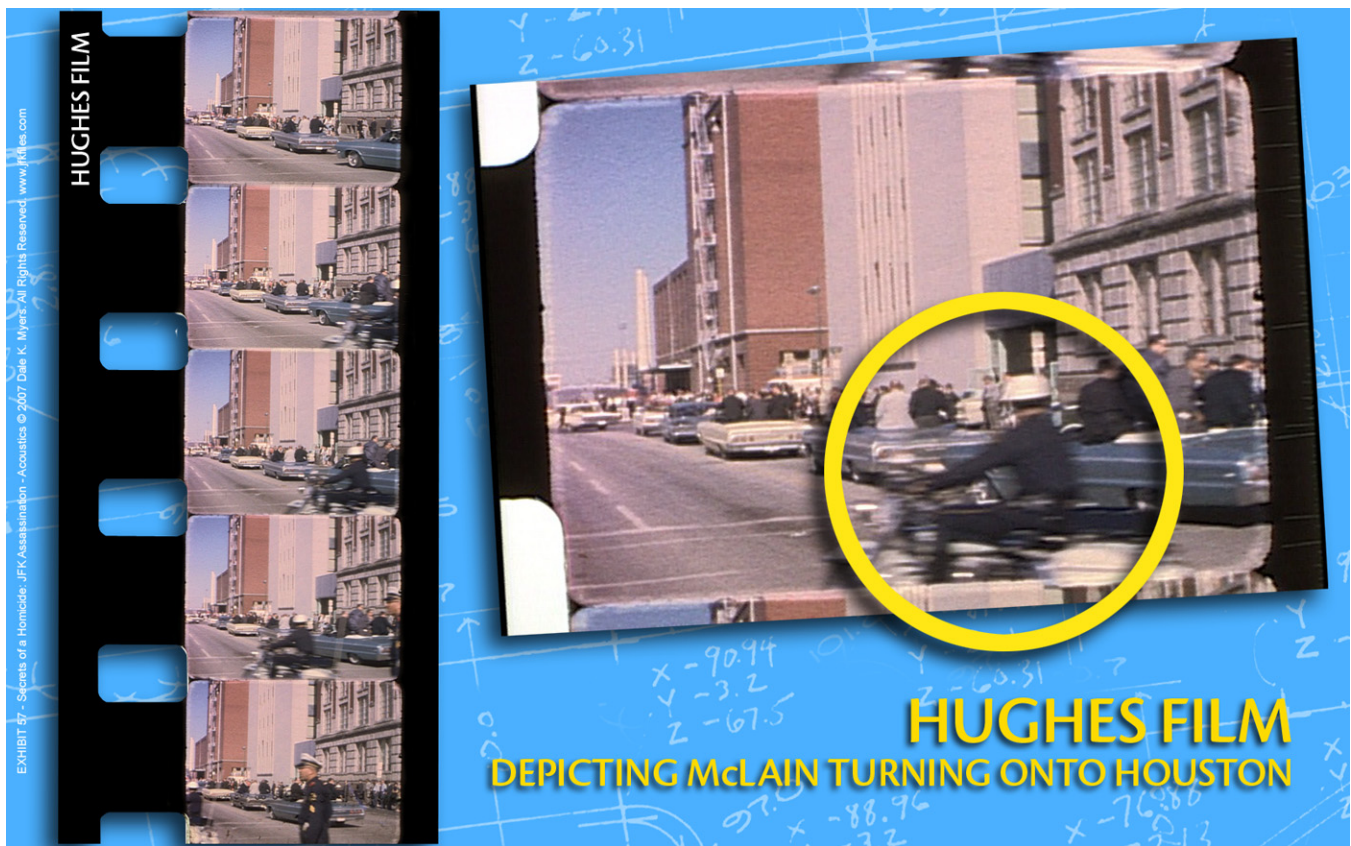


Exhibit 57. H.B. McLain turning from Main onto Houston Street as depicted in the Hughes film.

Texas School Book Depository...the place that the acoustics project suggested [the motorcycle] would be.”¹³⁵ The actual distance was over 200 feet.

Unfortunately for the HSCA, the Hughes film doesn’t actually show McLain in the position predicted by their acoustic analysis. The crucial sequence ends just as McLain reaches the crosswalk at Main and Houston, approximately 170 feet from the committee’s first shot position and more than 200 feet behind the presidential limousine. [See Exhibit 4, p.34]

Failing to perform any further analysis of the Hughes film sequence to determine its relationship to the shooting, the HSCA was left to draw the rather vague conclusion that McLain “would have been in the approximate position of the transmitting microphone, as indicated by the acoustical analysis.”¹³⁶

One obvious problem with the committee’s conclusion was how McLain managed to gain 80 feet on the limousine – putting him 120 feet behind the limousine as required by the acoustic evidence – before he reached the first shot position. In public hearings, Dr. Barger testified

135. 5HSCA617; 5HSCA626-27 JFK Exhibits F-669-71

136. *HSCA Report*, p.76

that McLain only had to “gain a bit on the presidential limousine as he came [up] Houston,” suggesting that the natural accordion-like motion of the motorcade (i.e., the tendency for the procession to accelerate and stretch out over straight portions of the route, then slow and bunch up at each turn) would have allowed McLain to gain the required 80 feet on the presidential limousine as it slowly made its turned onto Elm Street.¹³⁷

Yet, Barger’s explanation is demonstratively false. The Hughes film shows that the presidential limousine had already completed its turn onto Elm Street and begun to accelerate *before* McLain turned north onto Houston, eliminating the possibility of McLain gaining on the limousine in the manner Barger described. [Exhibit 58]

In addition, Barger himself testified that the sounds of the motorcycle engine on the acoustic recording remained *constant* – neither accelerating nor decelerating – until just 3 seconds before the first shot, when the engine sounds appear to slow considerably.¹³⁸ In essence, the recording itself is evidence that McLain *couldn’t have accelerated* to close the distance between his motorcycle and the presidential limousine in the way that Barger claimed.

The Dorman Film

In early 1979, just as the committee’s final report was about to go to press, the HSCA was presented with a third amateur film sequence by conspiracy theorist Robert Groden who claimed to have discovered photographic proof that McLain was in fact at the location and time specified by the acoustic experts. While the HSCA claimed not to have reviewed Groden’s work, they did report that Groden’s photographic exhibits “supported the committee’s conclusion.”¹³⁹

Groden’s photographic proof turned out to be the fifth sequence of an amateur film made by Mrs. Elsie Dorman, which depicts a motorcycle escort arriving at the corner of Elm and Houston. [Exhibit 59] Groden claimed that the motorcycle escort was H.B. McLain and that the sequence showed him arriving at the Elm and Houston corner at the time of the first shot – just as the acoustic evidence had predicted.

While the Dorman sequence does in fact depict McLain’s arrival at the Elm and Houston intersection, Groden’s assertion that the Dorman sequence synchronizes to the time of the assassination shots is demonstratively false.

137. 5HSCA650-51

138. 5HSCA678

139. *HSCA Report*, p.75 footnote 12

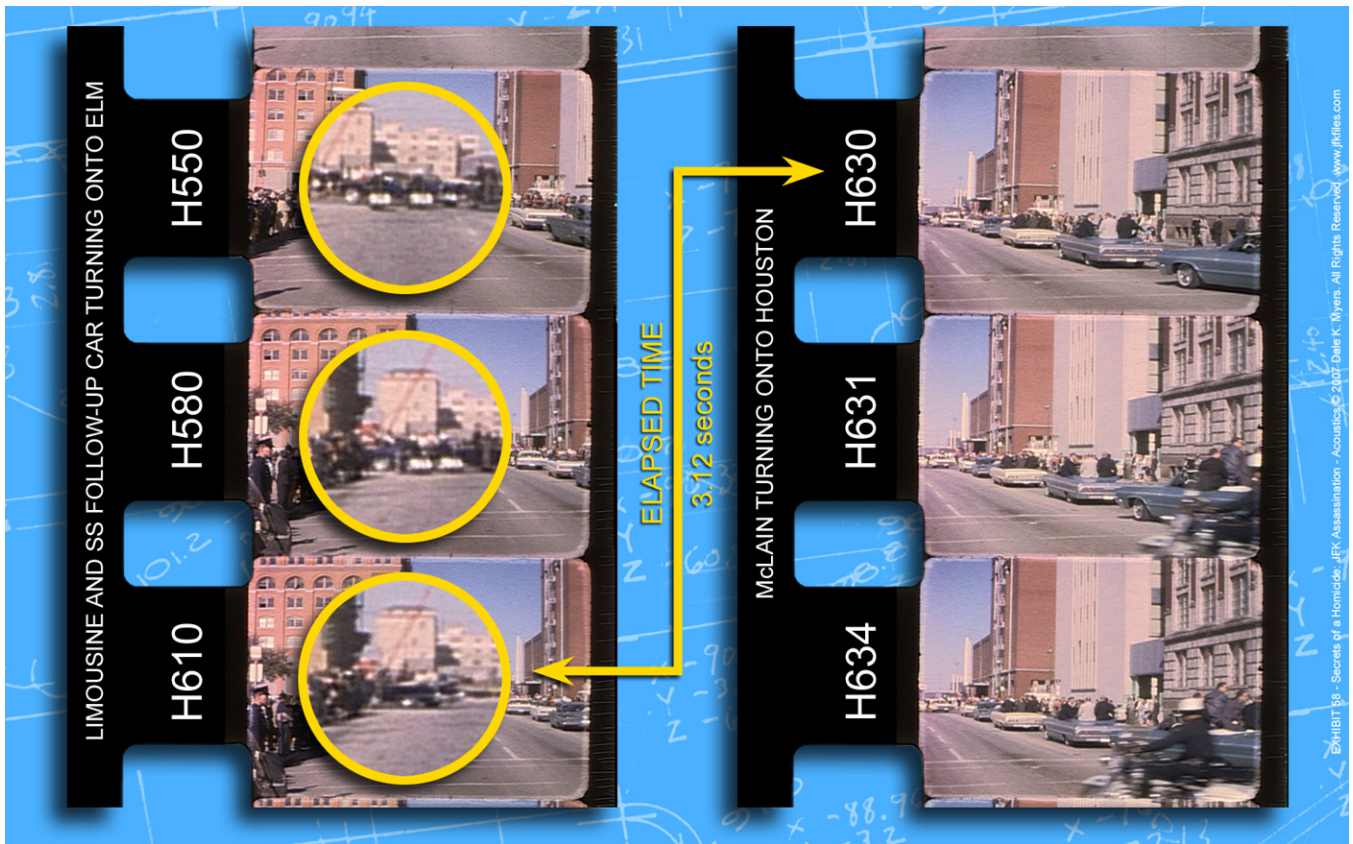


Exhibit 58. Hughes film depicts limousine turning onto Elm Street before H.B. McLain reaches Houston.

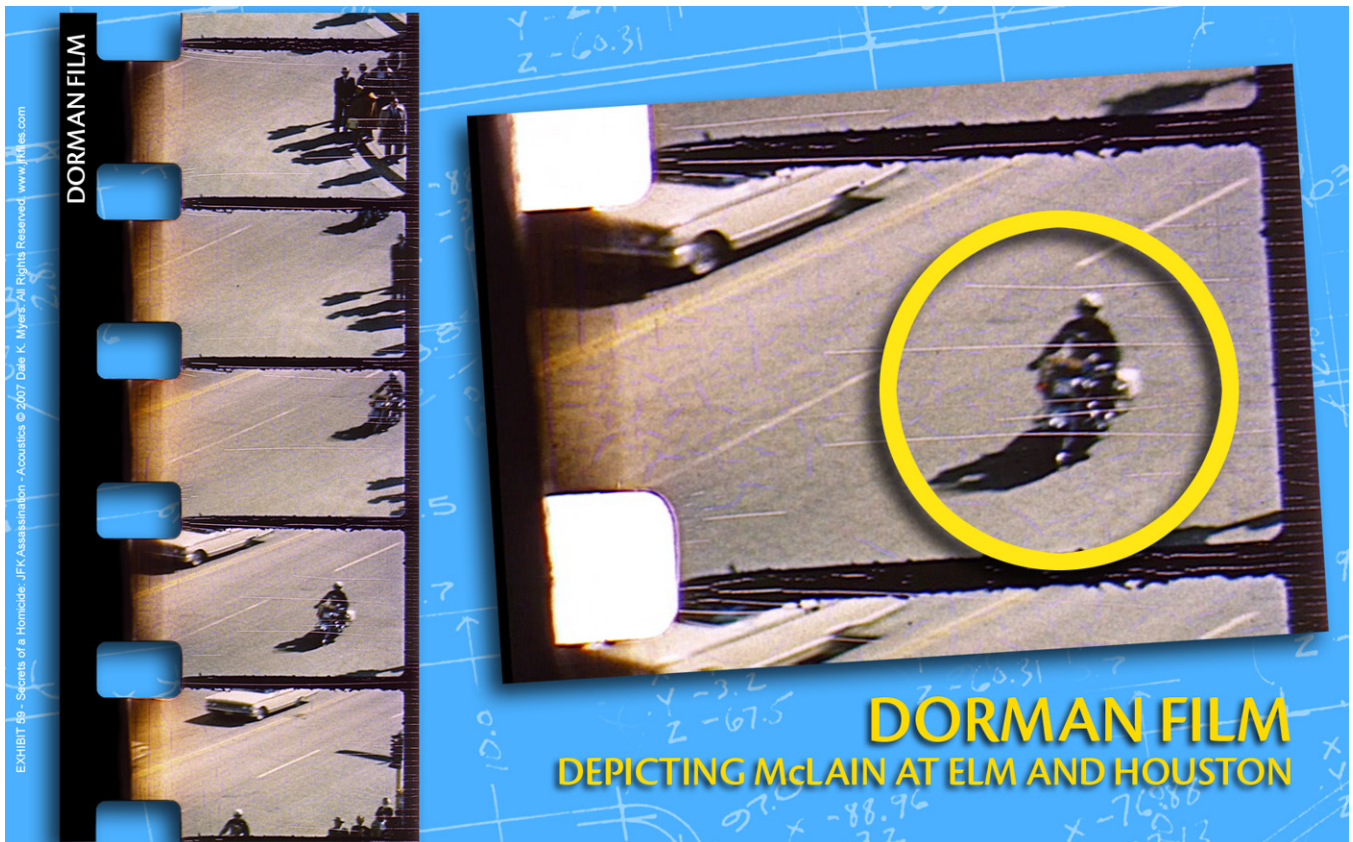


Exhibit 59. Dorman film depicts H.B. McLain arriving at Elm and Houston intersection.

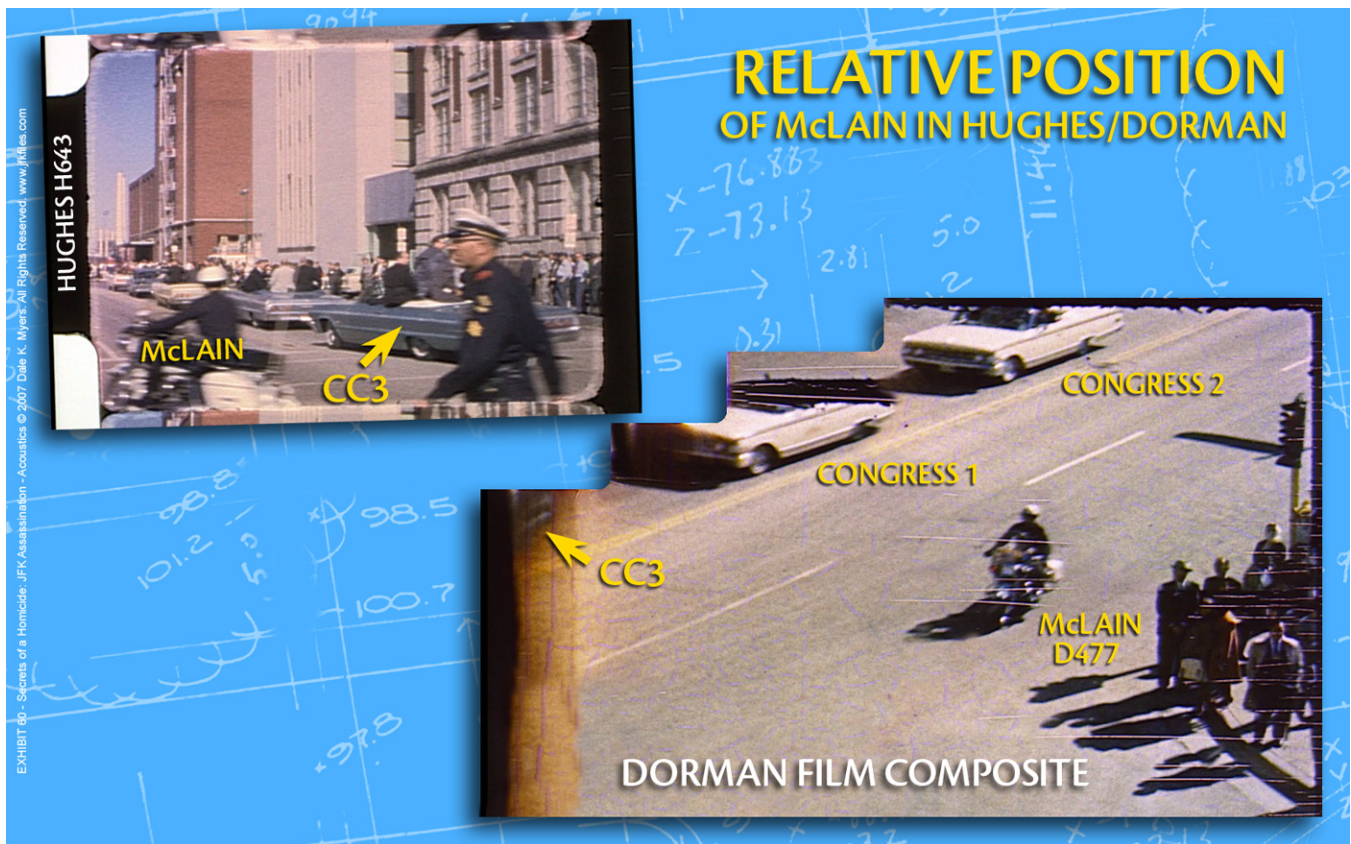


Exhibit 60. H.B. McLain's relative position in the motorcade as depicted in the Hughes and Dorman films.

H.B. McLain in the Dorman Film

Three facts support the belief that the motorcycle officer in the Dorman film is H.B. McLain. First, the motorcycle officer in the Dorman film is seen riding on the left side of motorcade between Camera Car 3 and Congressional Car 1 – the same relative position occupied by McLain throughout the entire motorcade¹⁴⁰ and the precise position occupied by McLain twelve seconds earlier, as depicted in the Hughes film. [Exhibit 60]

Second, the motorcycle officer in the Dorman film has a white object attached to the inside lower-left corner of his windshield. A similar white object is visible on McLain's motorcycle twelve seconds earlier, as depicted in the Hughes film. [Exhibit 61]

McLain testified that the white object was his paper work which he kept fastened to the inside of the motorcycle's windshield with two clip holders. This was one of several identifying characteristics which allowed McLain to identify his motorcycle from others used by the

140. Various photographs and films of the motorcade show McLain and escort partner Marion L. Baker positioned slightly ahead of or behind Camera Car 3. An amateur film of the motorcade by Patsy Paschall, taken one block before Dealey Plaza, shows Baker riding between Camera Cars 2 and 3 and McLain riding adjacent to Congressional Car 1.



Exhibit 61. White object in the lower-left corner of McLain's windshield visible in Hughes and Dorman films.

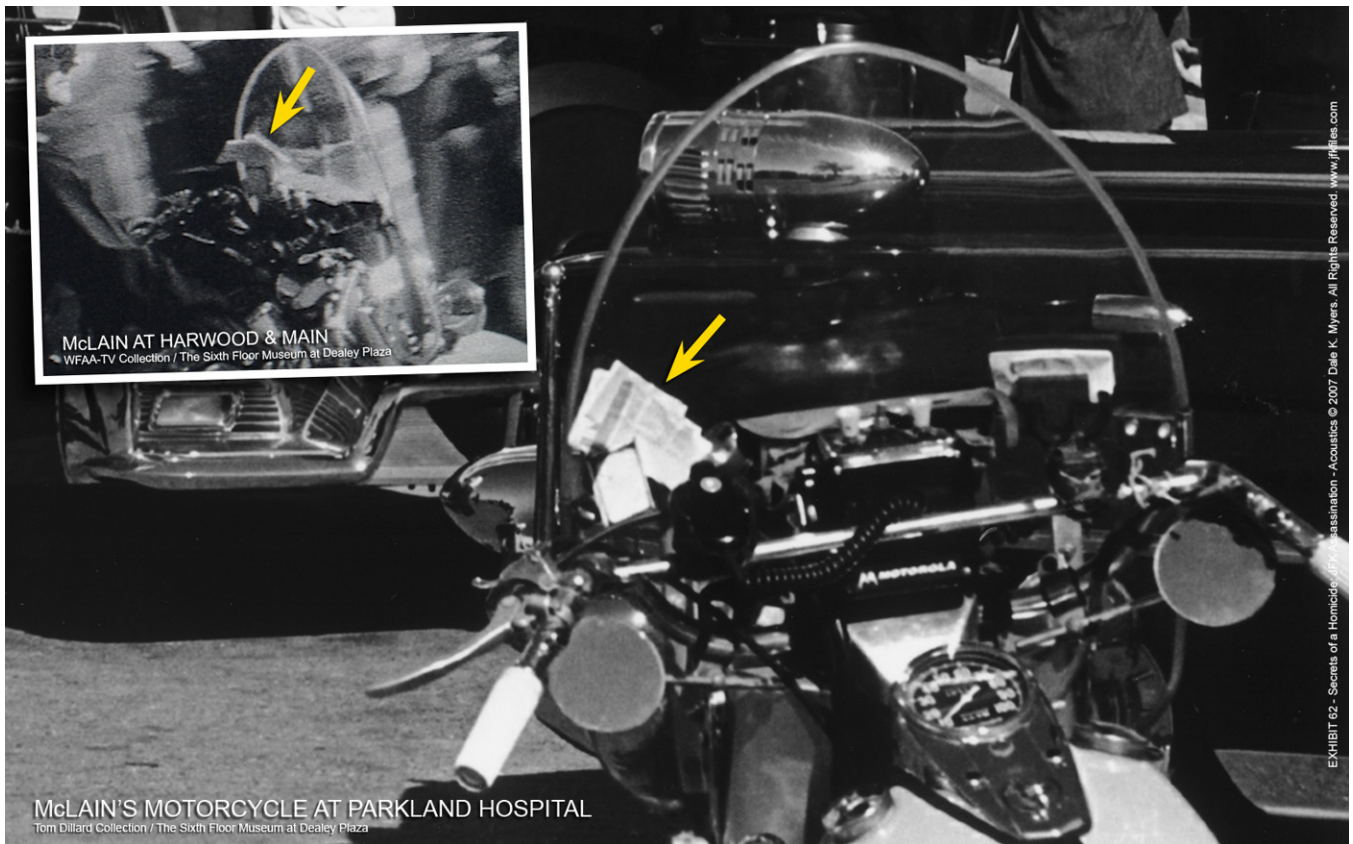


Exhibit 62. Paper work mounted in the lower-left corner of H.B. McLain's windshield.

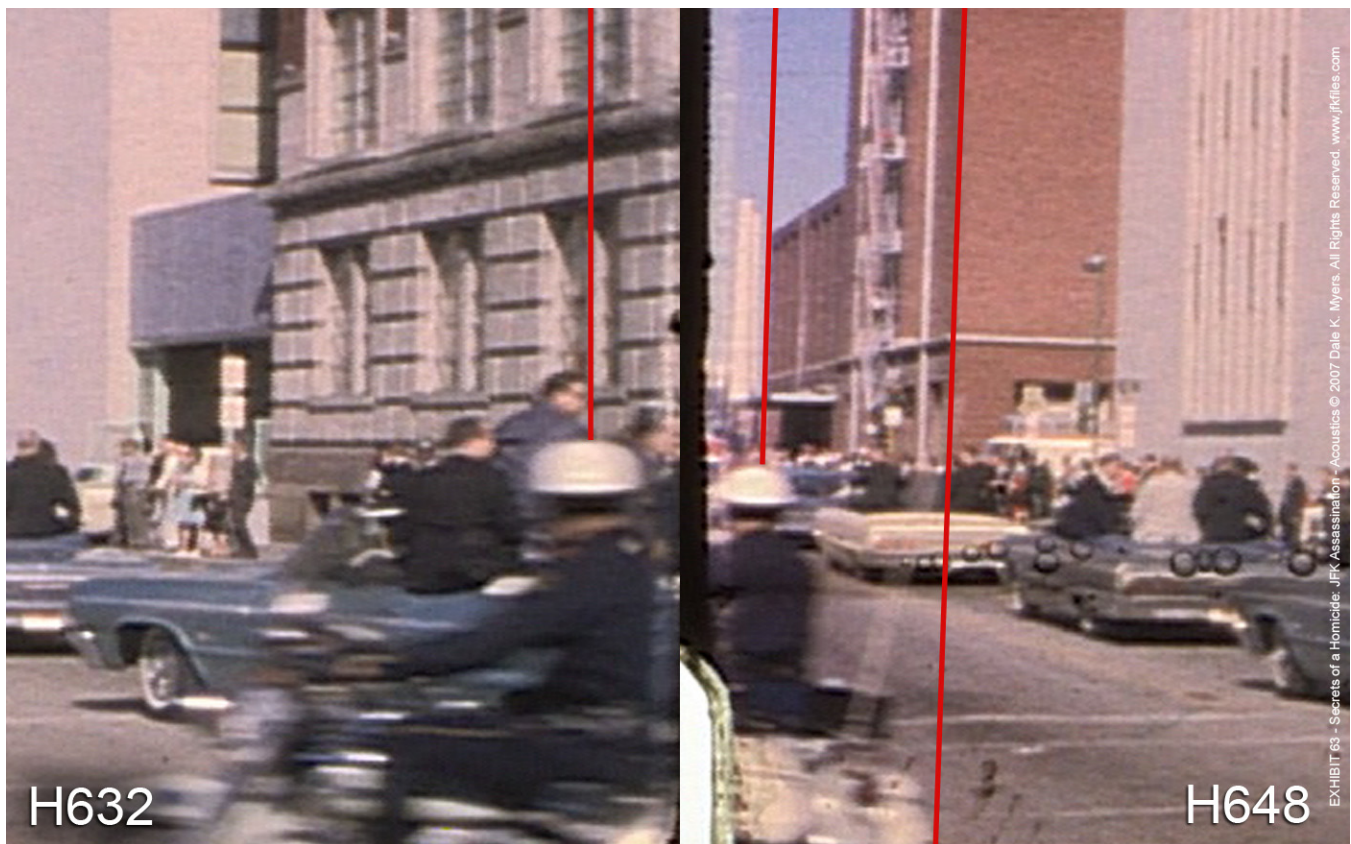


Exhibit 63. Plotting the position of H.B. McLain at Hughes frames H632 and H648.

police department.¹⁴¹ High quality photographs taken before and after the assassination show this unique feature of McLain's motorcycle. [Exhibit 62]

Third, the trajectory and speed of the motorcycle officer in the Dorman film is consistent with the projected trajectory and speed of McLain's motorcycle, as depicted in the Hughes film.

To determine Officer McLain's trajectory and speed as seen in the Hughes film, a computer model of McLain's motorcycle was positioned to match Hughes frame H632 (the second frame in which McLain appears) by noting the motorcycle's relationship to a line-of-sight drawn between Hughes' camera and the windows on the west wall of the Dallas County Courthouse building. A computer model of the motorcycle was also positioned to match Hughes frame H648 (the last frame in which McLain appears) by noting the motorcycle's relationship to lines-of-sight drawn between Hughes' camera and the northwest and southwest corners of the Dal-Tex Building. [Exhibit 63] The distance between these two positions (Hughes frames H632-H648) was measured at 18.79 feet. McLain traversed this distance over the course of 16

141. 5HSCA631 [Note: Two other identifying characteristics were a chrome break drum mounted right-facing on the front wheel, instead of left-facing; and a flashlight holder that was mounted crossways on the handlebar, instead of up and down. Neither characteristic is sufficiently visible in the Dorman film to make a positive identification.]

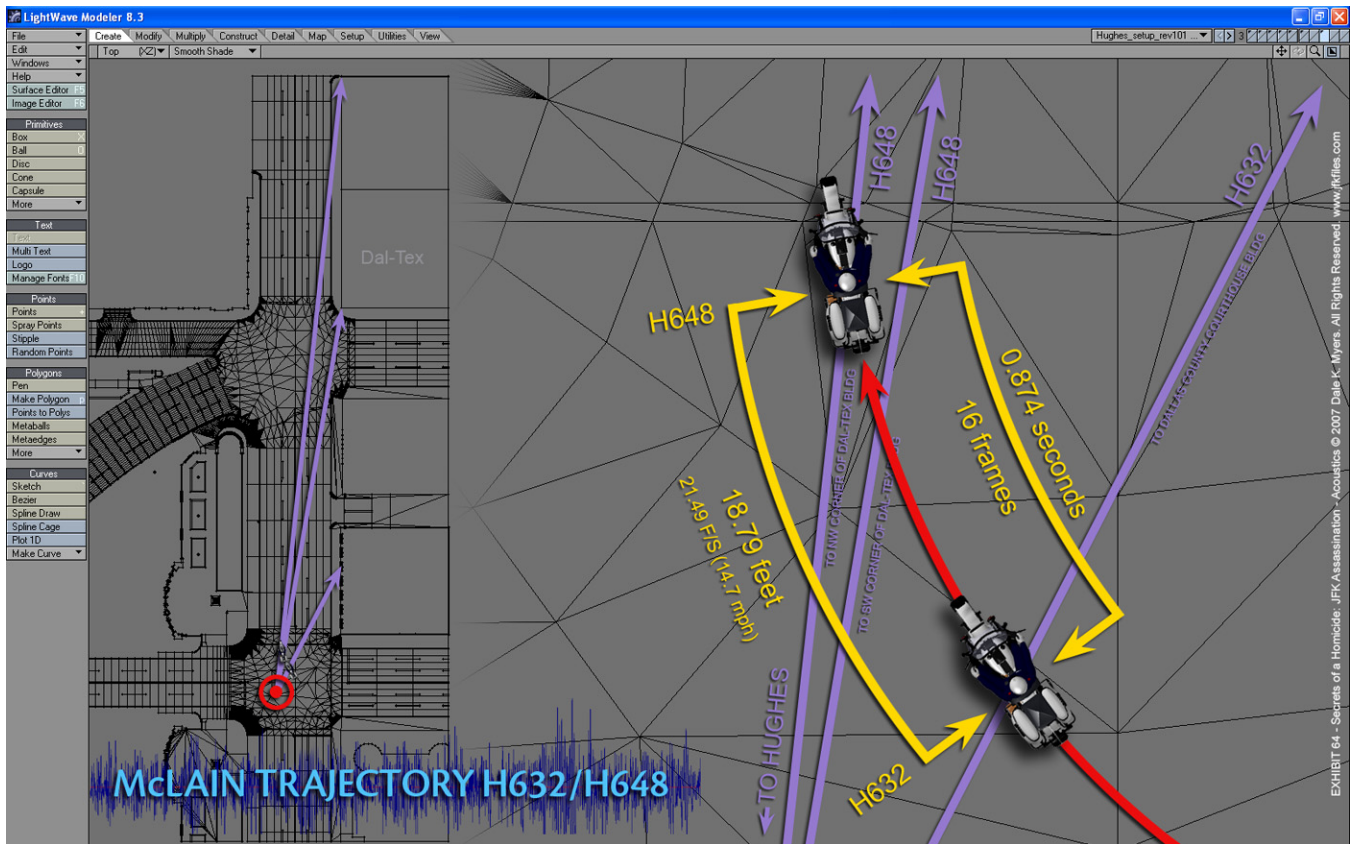


Exhibit 64. Plotting the distance traversed by H.B. McLain between Hughes frames H632 and H648.

frames. Dividing the speed of the Hughes camera (18.3 frames/second) into the frame count yields a time of 0.874 seconds. This calculates to a speed of 21.49 feet/second (14.7 mph) as McLain turns the corner from Main onto Houston Street. [Exhibit 64]

To fix the trajectory and speed of the motorcycle officer seen in the Dorman film, multiple Dorman frames were used to create a mosaic image, which illustrated the precise location of the motorcycle officer at Dorman frames D456 (the first frame in which the motorcyclist appears) and D496 (the last frame in which he appears). A line-of-sight was projected from Dorman's point-of-view, through both motorcycle positions, to the Dallas County Courthouse Building visible in the background. [Exhibit 65] These lines-of-sight were then transferred to a computer model of Dealey Plaza. Computer models of a motorcycle were also matched to the locations shown. The distance between these two positions (Dorman frames D456-D496) was measured at 28 feet. The motorcyclist traversed this distance over the course of 40 frames. Dividing the speed of the Dorman camera (16.8 frames/second) into the frame count yields a time of 2.38 seconds. This calculates to a speed of 11.77 feet/second (8.0 mph). [Exhibit 66]

The distance between McLain's position at Hughes frame H648 and the motorcyclist's position at Dorman D456 was measured at 159.5 feet. Since Hughes frame H648 is the equivalent of Zapruder frame Z150 and Dorman frame D456 is the equivalent of Zapruder frame Z365 [See *The Wiegman Film*, p.96], then a period of 11.75 seconds ($Z365 - 150 = 215 \div 18.3 = 11.75$

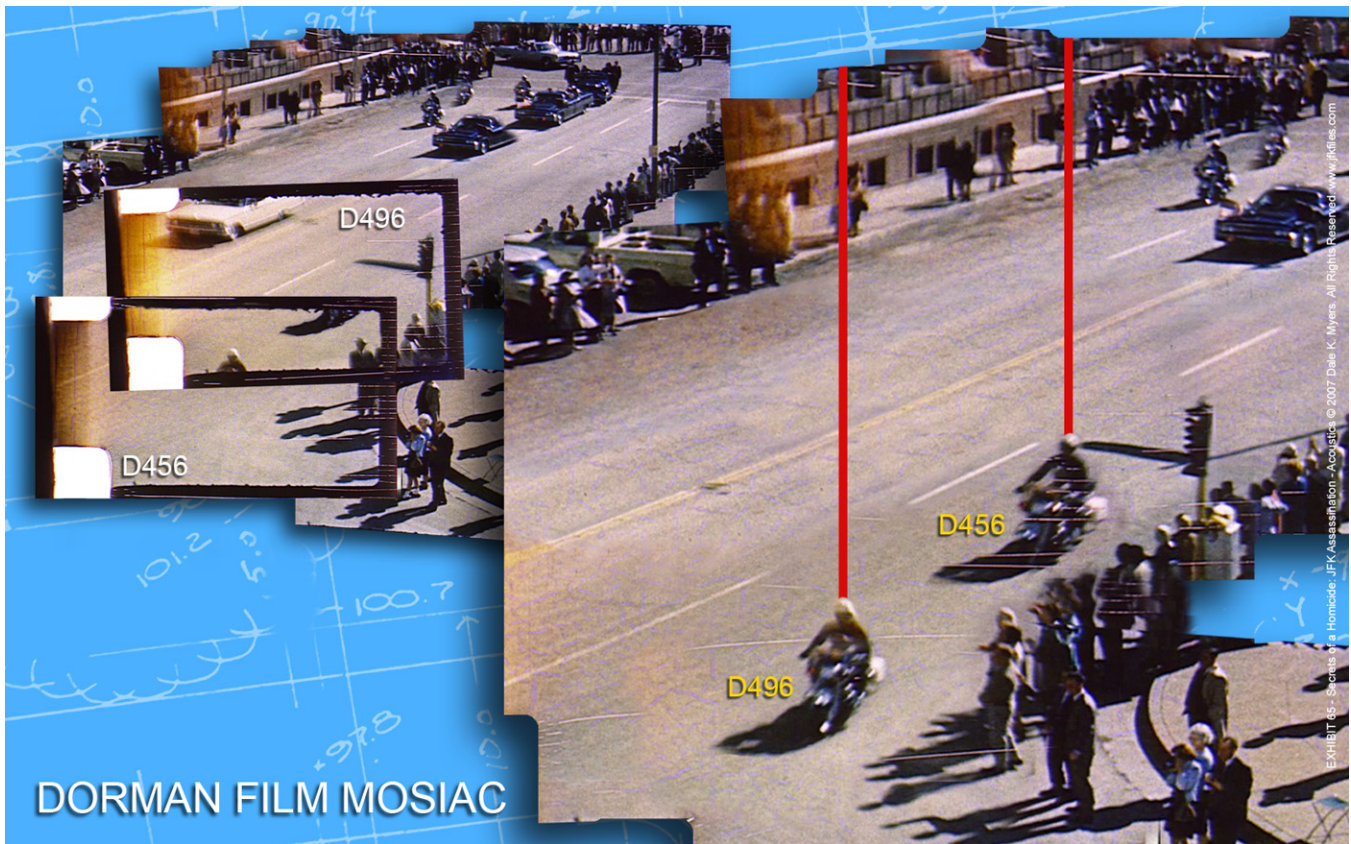


Exhibit 65. Composite mosaic image used to position H.B. McLain at Dorman frames D456 and D496.

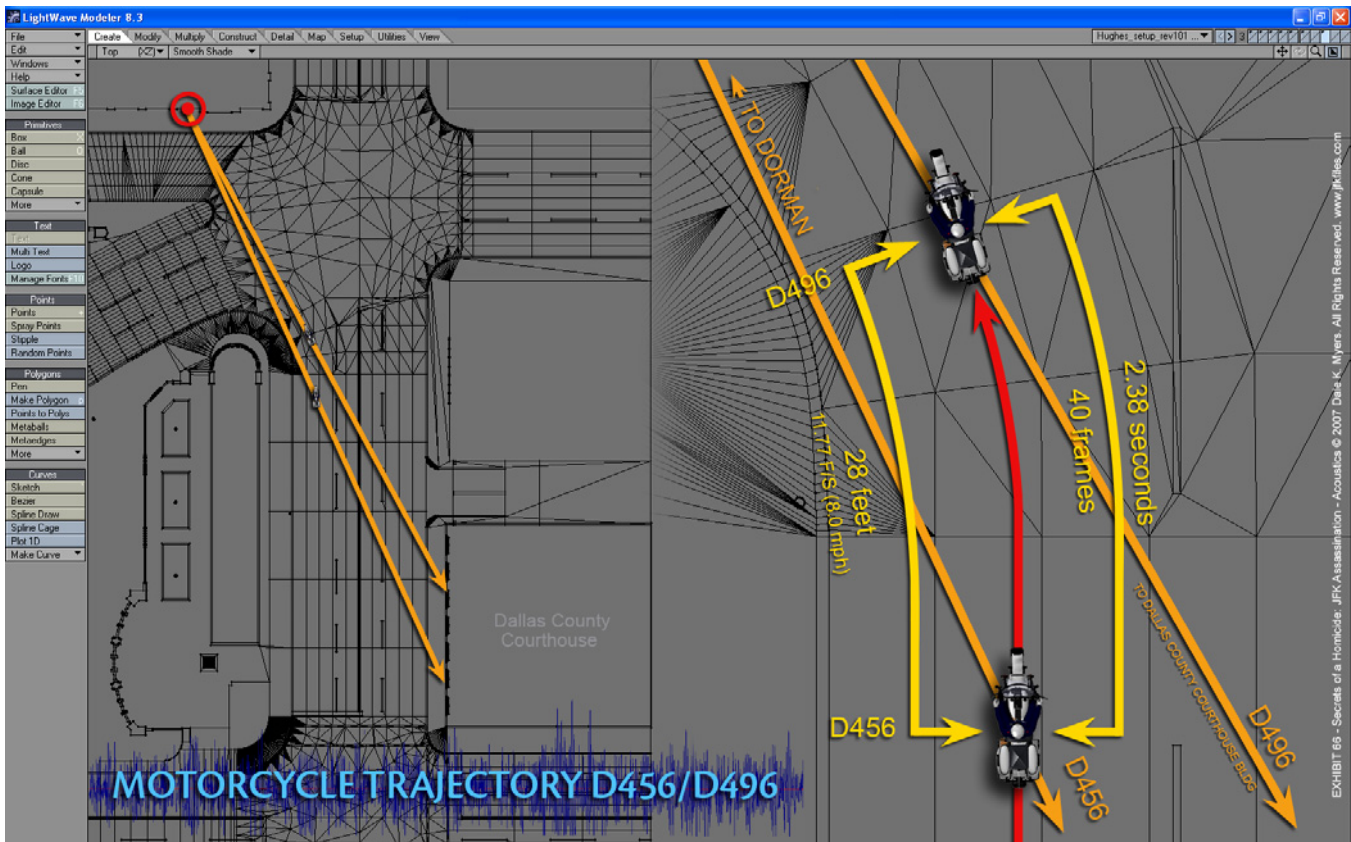


Exhibit 66. Plotting the distance traversed by H.B. McLain between Dorman frames D456 and D496.

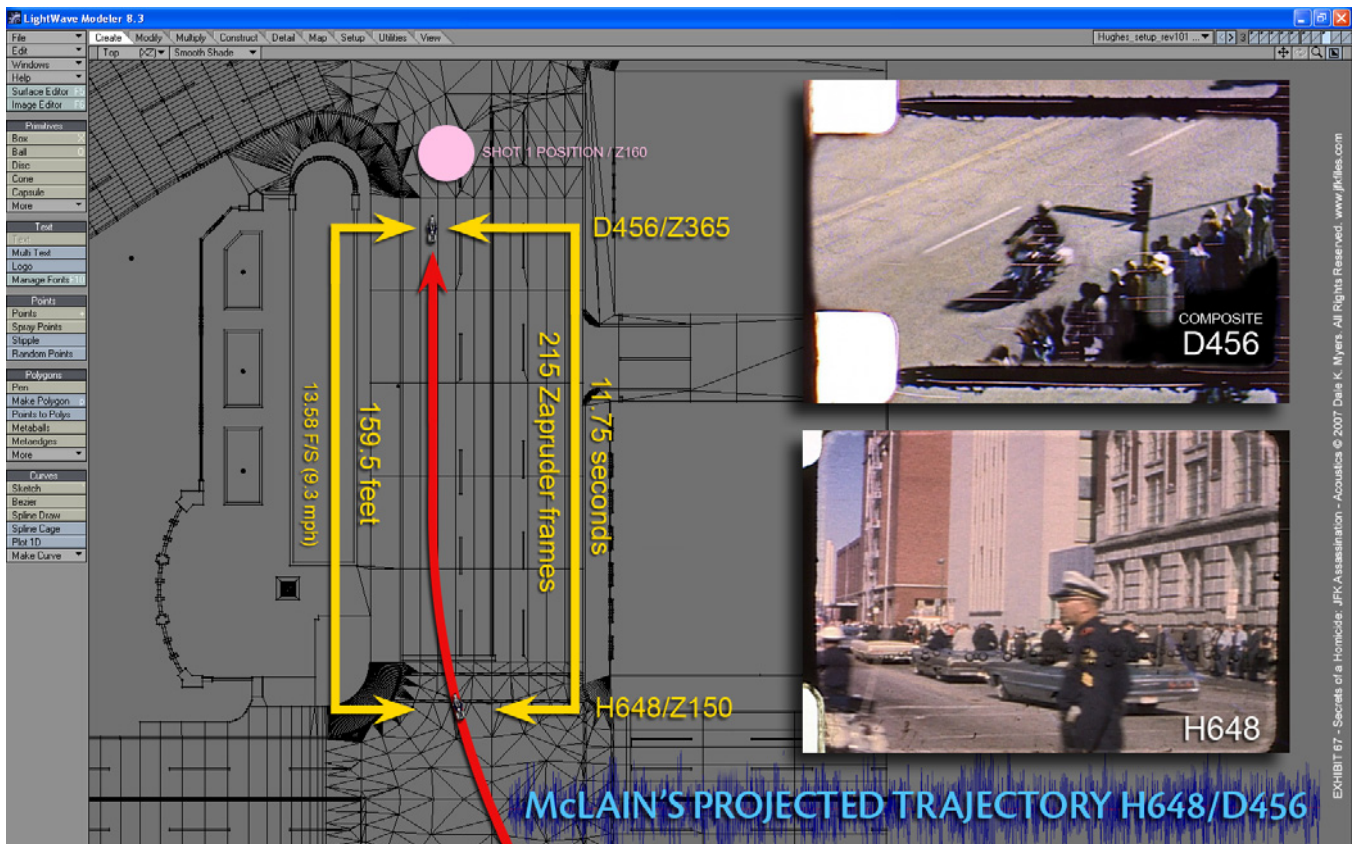


Exhibit 67. Plotting the distance traversed by H.B. McLain between Hughes H648 and Dorman D456.

sec) is known to have elapsed between McLain's last appearance in the Hughes film and the motorcycle officer's appearance in the Dorman film. If McLain continues north on Houston Street at an average speed of 13.58 feet/second (9.3 mph), the approximate speed of the motorcade, he will traverse 159.5 feet in 11.75 seconds and arrive at the corner of Elm and Houston at the time depicted in the Dorman film. [Exhibit 67]

The unique identifying characteristics of McLain's motorcycle, his relative position in the motorcade procession on Houston Street as depicted in both the Hughes and Dorman films, and the consistency of his speed and trajectory in the Hughes film with that of the motorcyclist in the Dorman film is nearly conclusive evidence that the motorcycle officer in the Dorman film is in fact H.B. McLain.

Synchronizing the Dorman and Zapruder Films

The Dorman film sequence depicting McLain's arrival at the Elm and Houston intersection does not, however, synchronize to the time of the shooting as Groden claimed, but rather synchronizes to a point after the shooting had ended. This is demonstratively proven by examining details visible in the Dorman sequence immediately preceding the one depicting Officer McLain.

A stabilized portion of the fourth sequence of the Dorman film (D345-D355) shows amateur photographer Hugh Betzner Jr., lowering his camera after taking a photograph of the President's car. The photograph was taken at the equivalent of Zapruder frame Z186.¹⁴² [Exhibit 68] In the margins of the Zapruder film, between frames Z195 and Z206, Betzner is also visible lowering his camera exactly as he does in the Dorman film. [Exhibit 69] This action provides a synchronization point.

Everything that follows this moment in the Dorman film must occur *after* Zapruder frame Z206 – in other words, *after* the shooting began.

An examination of the Dorman film shows that there is a brief camera stop after this sequence and then Mrs. Dorman resumes filming. When Sequence 5 of the Dorman film begins, six continuous seconds elapse before Officer McLain appears at the corner.

Consequently, McLain's arrival at the corner of Elm and Houston is *not* at the time of the first shot – as Groden claimed, and the acoustic evidence dictates – but at least 8 seconds *after* the shooting began, or, for all practical purposes, after the shooting was over.

The precise relationship between McLain's arrival at the corner of Elm and Houston as depicted in Dorman sequence D456-D496, and the shooting as depicted in the Zapruder film can be determined by synchronizing the Dorman and Zapruder films using the 16mm news film shot by Dave Wiegman, Jr.

The Wiegman Film

Dave Wiegman was an NBC cameraman riding in Camera Car 1, the tenth automobile in the motorcade. When the shooting began, Wiegman turned on his 16mm news camera, which ran at 24 frames-per-second, jumped from the car in front of the Texas School Book Depository and ran down toward the north pergola.

A computer-assisted geometric analysis of both the Wiegman and Zapruder films demonstrates that Wiegman frame W265, depicting the presidential limousine approaching the Triple Underpass, is the equivalent of Zapruder frame Z447. This was determined by plotting a line-of-sight on a computer model of Dealey Plaza between Wiegman's position at Wiegman frame W265 and the U.S. flag mounted on the right-front fender of the presidential limousine visible in the background of that same frame. A second line-of-sight was then plotted between Zapruder's position and the lamppost on the north side of Elm Street nearest to the limousine's

142. Betzner reported hearing two shots. He had just taken his third photograph (the equivalent of Z186) and began to wind the film in his camera when he heard the first shot, which he thought was either a firecracker or a car backfire. The timing places this "first" shot at about Z223. Betzner then looked up and heard a second shot within a matter of seconds and saw what looked like a firecracker going off in the President's car, as fragments flew up in the air. This "second" shot is a clear reference to the fatal head shot at Z313. [Trask, Richard B., *Pictures of the Pain*, Yeoman Press, 1994, pp.160-162]



Exhibit 68. Dorman frame sequence D345-D355 depicting Hugh Betzner after taking his third photograph.

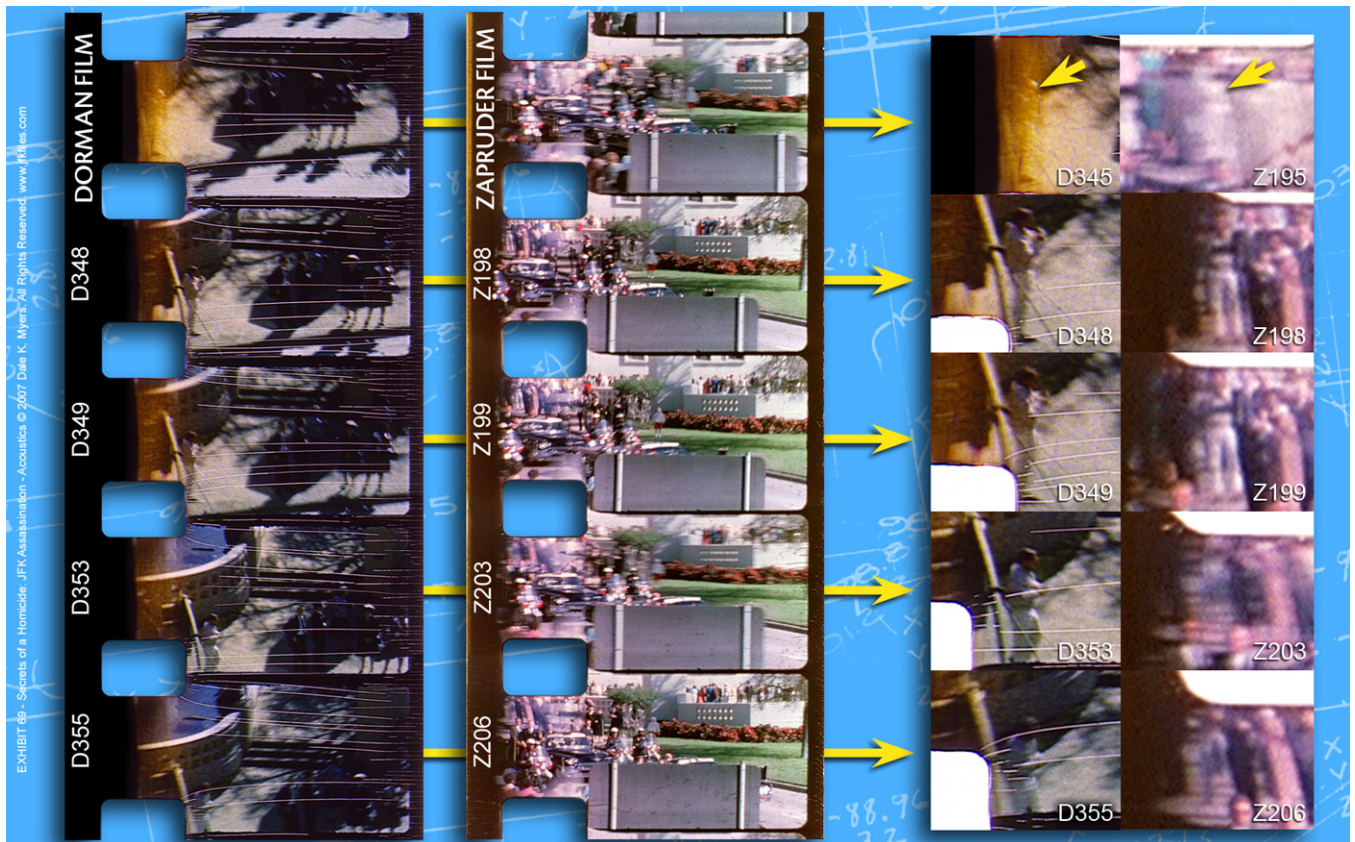


Exhibit 69. Synchronization of Dorman frames D345-D355 and Zapruder frames Z195-Z206.

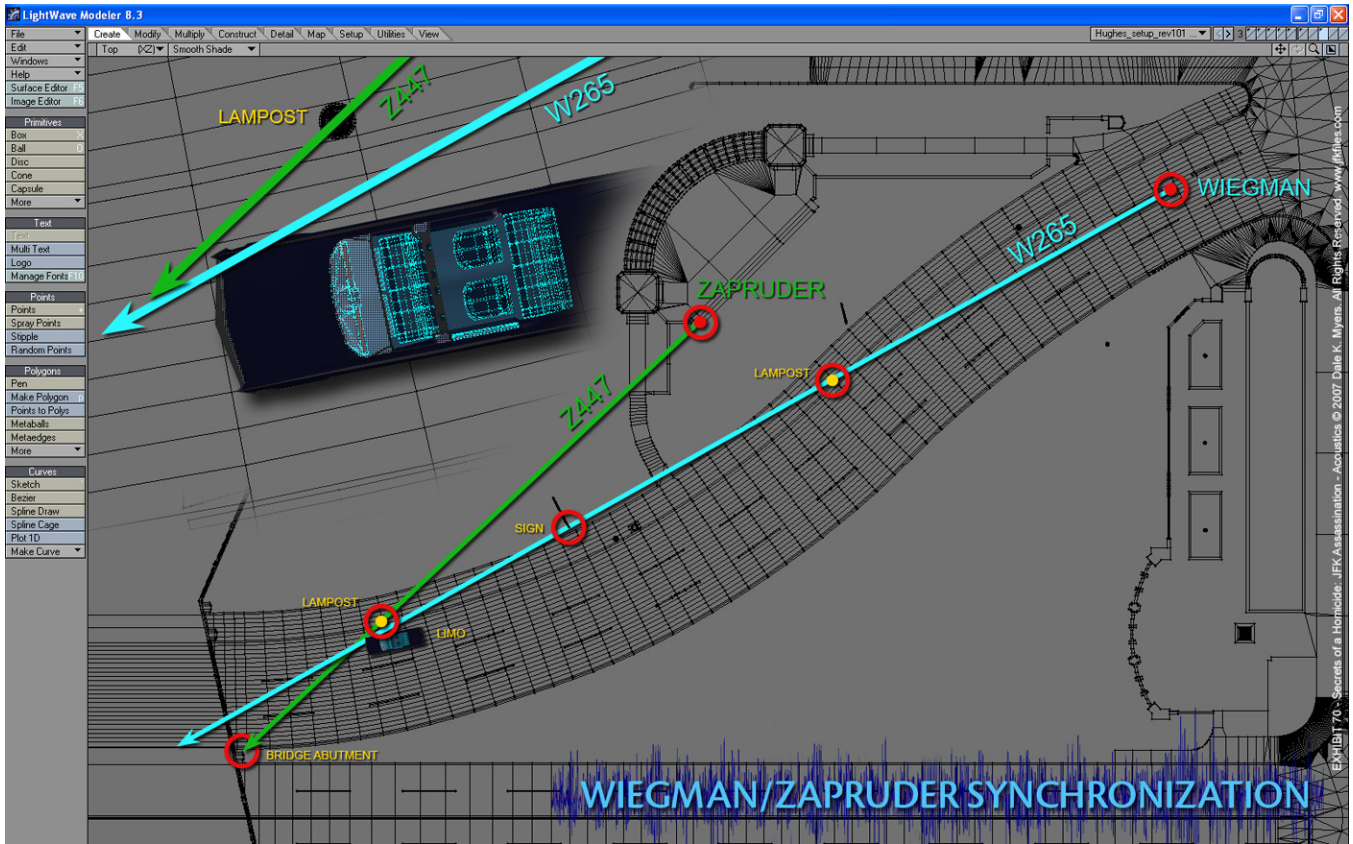


Exhibit 70. Plotting the relationship between the Wiegman and Zapruder films based on the limousine.

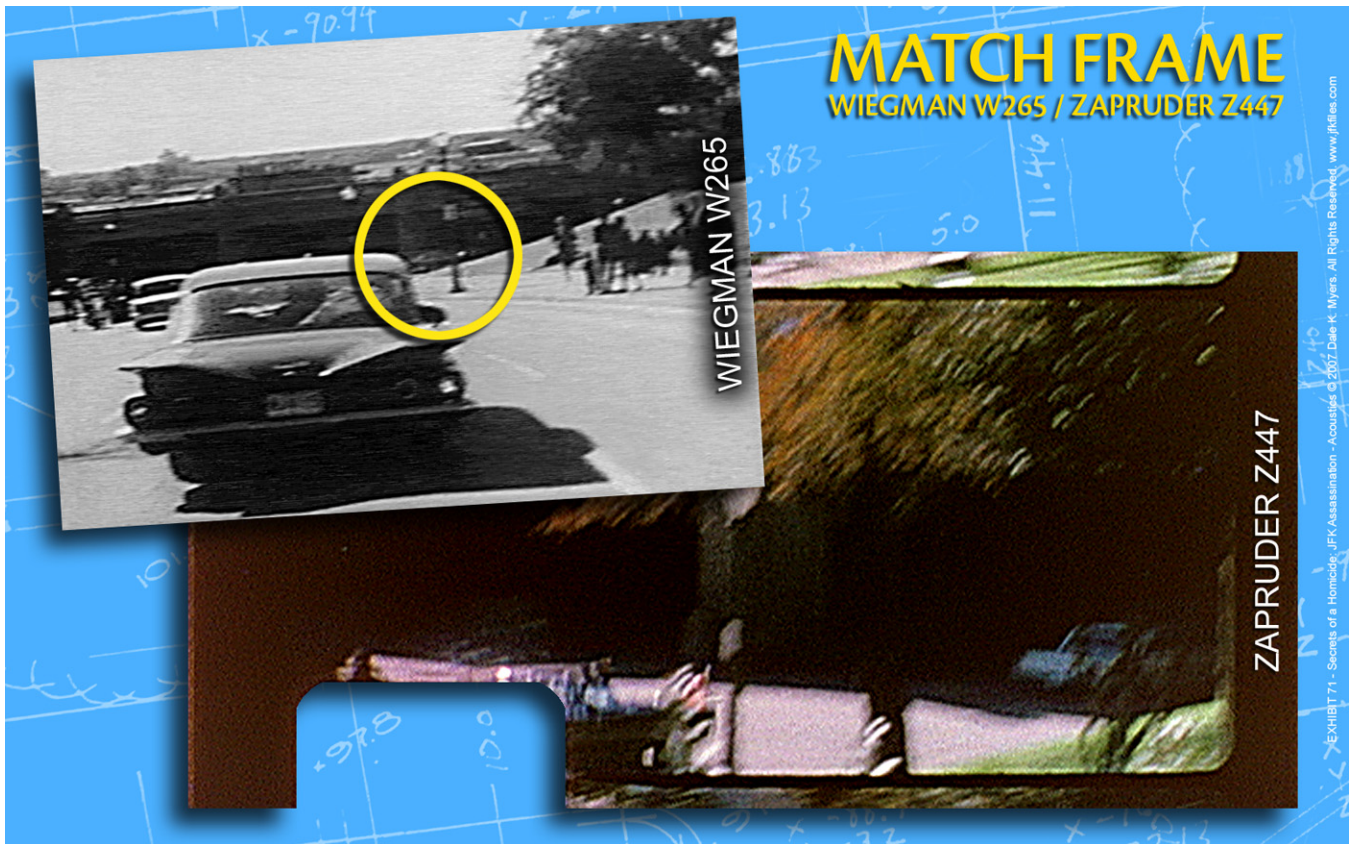


Exhibit 71. Wiegman frame W265 is the equivalent of Zapruder frame Z447.

position, as depicted in the Wiegman film. ^[Exhibit 70] The Zapruder film was then studied to determine the frame at which the presidential limousine matched the location indicated by the two lines-of-sight. The Zapruder frame matching the position of the limousine at Wiegman frame W265 is Zapruder frame Z447. ^[Exhibit 71]

To determine the relationship of the Dorman film to the Wiegman film (and thus, its relationship to the Zapruder film), an examination was made of the movements of Mayor Earle Cabell's car, the eighth automobile in the motorcade, which appears in both films.

Using the Wiegman and Dorman films, as well as measurements obtained from a computer model of Dealey Plaza, it was possible to triangulate the trajectory and speed of Mayor Cabell's car as it passed the Texas School Book Depository, and thus, synchronize the two films. The results show that:

(a) Mayor Cabell's car at Wiegman frame W015 was determined to be 19.2 feet from its position at Dorman frame D376.

Mayor Cabell's car was a 1963 Mercury Comet which had an overall length of 194.8 inches (16.2 feet).¹⁴³ A computer model of Mayor Cabell's car was positioned to match Wiegman frame W015 by noting the vehicle's relationship to a line-of-sight drawn between Wiegman's camera and the western edge of the fourth window alcove located west of the entrance to the Texas School Book Depository. A computer model of Mayor Cabell's car was also positioned to match a composite version of Dorman frame D376¹⁴⁴ by noting the vehicle's relationship to a line-of-sight drawn between Dorman's camera and the curved concrete wall rimming the reflecting pool on the south side of Elm Street. The left rear window of Mayor Cabell's car lies along this line-of-sight. The distance between these two positions (rear bumper-to-rear bumper) was measured at 19.2 feet. ^[Exhibits 72 & 73]

(b) A computer model of the position of Mayor Cabell's car at Dorman frame D376 and D390 shows that it traverses a distance of 13.69 feet.

A computer model of Mayor Cabell's car was positioned to match a composite version of Dorman frame D376 as described above. [See, (a)] A computer model of Mayor Cabell's car was also positioned to match a composite version of Dorman frame D390 by noting the vehicle's relationship to a line-of-sight drawn between Dorman's camera and the concrete tower located west of the reflecting pool on the south side of Elm Street. The left rear window of Mayor Cabell's car lies along this line-of-sight. The distance between these two positions (left-rear window to left-rear window) was measured at 13.69 feet. ^[Exhibit 74]

143. Gunnell, John, *Standard Catalog of American Cars, 1946-1975, Revised 4th Edition*, Krause Publications, 2002, p.524

144. Composite frames were created from multiple frames which allowed objects to be seen in relation to fixed objects which were out of the field-of-view at the time of exposure.

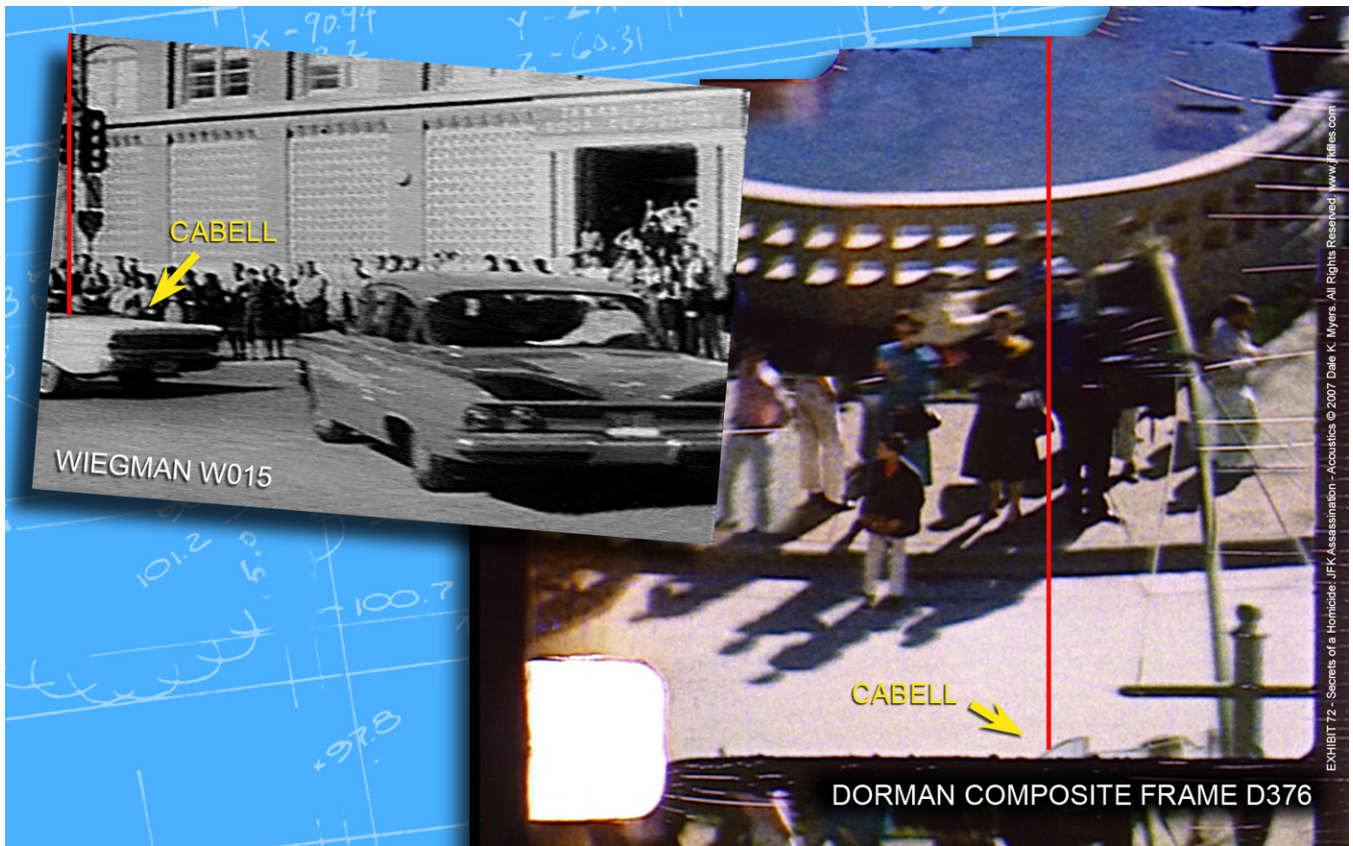


Exhibit 72. Plotting the position of Mayor Cabell's car at Wiegman Frame W015 and Dorman frame D376.

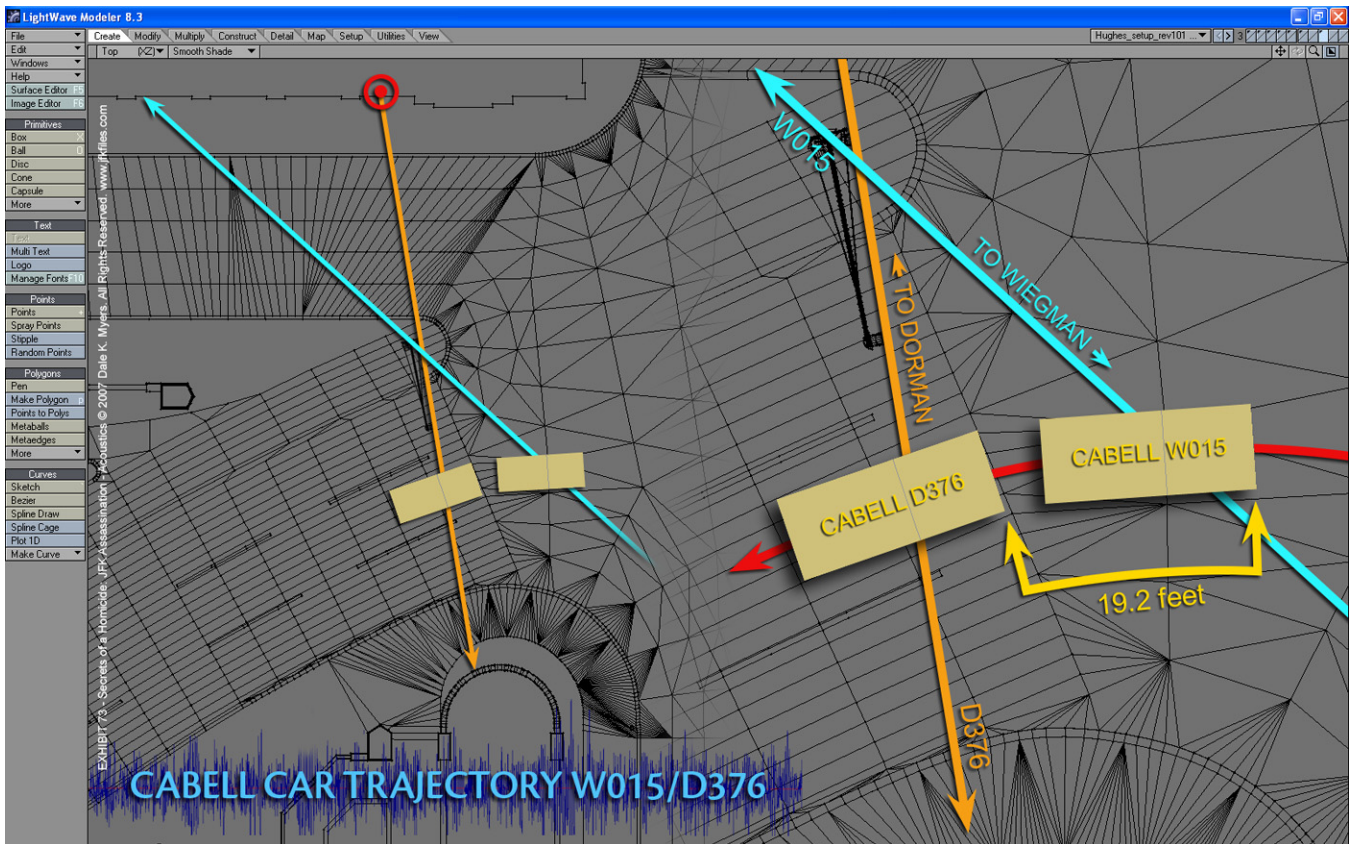


Exhibit 73. Plotting the distance traversed by Mayor Cabell's car between Wiegman W015 and Dorman D376.



Exhibit 74. Plotting the position of Mayor Cabell's car at Dorman frames D376 and D390.

(c) Mayor Cabell's car speed between Dorman frames D376-D390 was calculated to be 16.44 feet/second (11.2 mph).

During the period defined by Dorman frames D376-D390, Mayor Cabell's car traverses a distance of 13.69 feet in 14 frames. Dividing the speed of the Dorman camera (16.8 frames/second) into the frame count yields a time of 0.833 seconds. This calculates to a speed of 16.44 feet/second (11.2 mph). [Exhibit 75]

(d) Mayor Cabell's car would have traversed the 19.2 feet between Wiegman frame W015 and Dorman frame D376 in 1.17 seconds traveling at an estimated speed of 16.44 feet/second (11.2 mph).

Dividing the distance of 19.2 feet by the estimated speed of 16.44 feet/second (11.2 mph) yields a time period of 1.17 seconds.

In conclusion, the four calculations above demonstrate that Mayor Cabell's car would have traversed the 19.2 foot distance between its known positions at Wiegman frame W015 and Dorman frame D376 in 1.17 seconds. This time period is equal to 28 Wiegman frames ($1.17 \times 24\text{fps} = 28$). Consequently, Dorman frame D376 is the equivalent of Wiegman frame W043 ($W015 + 28 = W043$). [Exhibit 76]

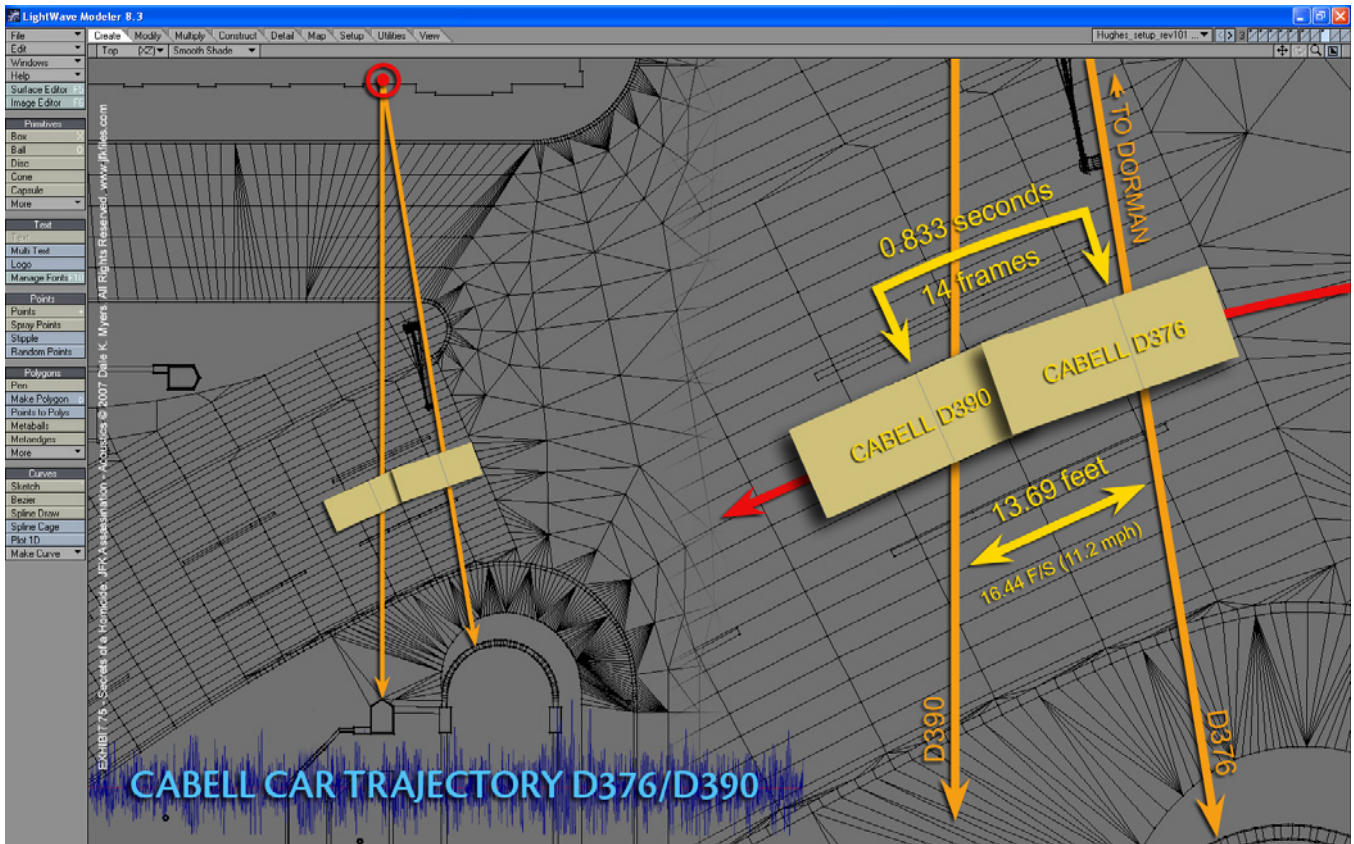


Exhibit 75. Plotting the distance traversed by Mayor Cabell's car between Dorman D376 and Dorman D390.

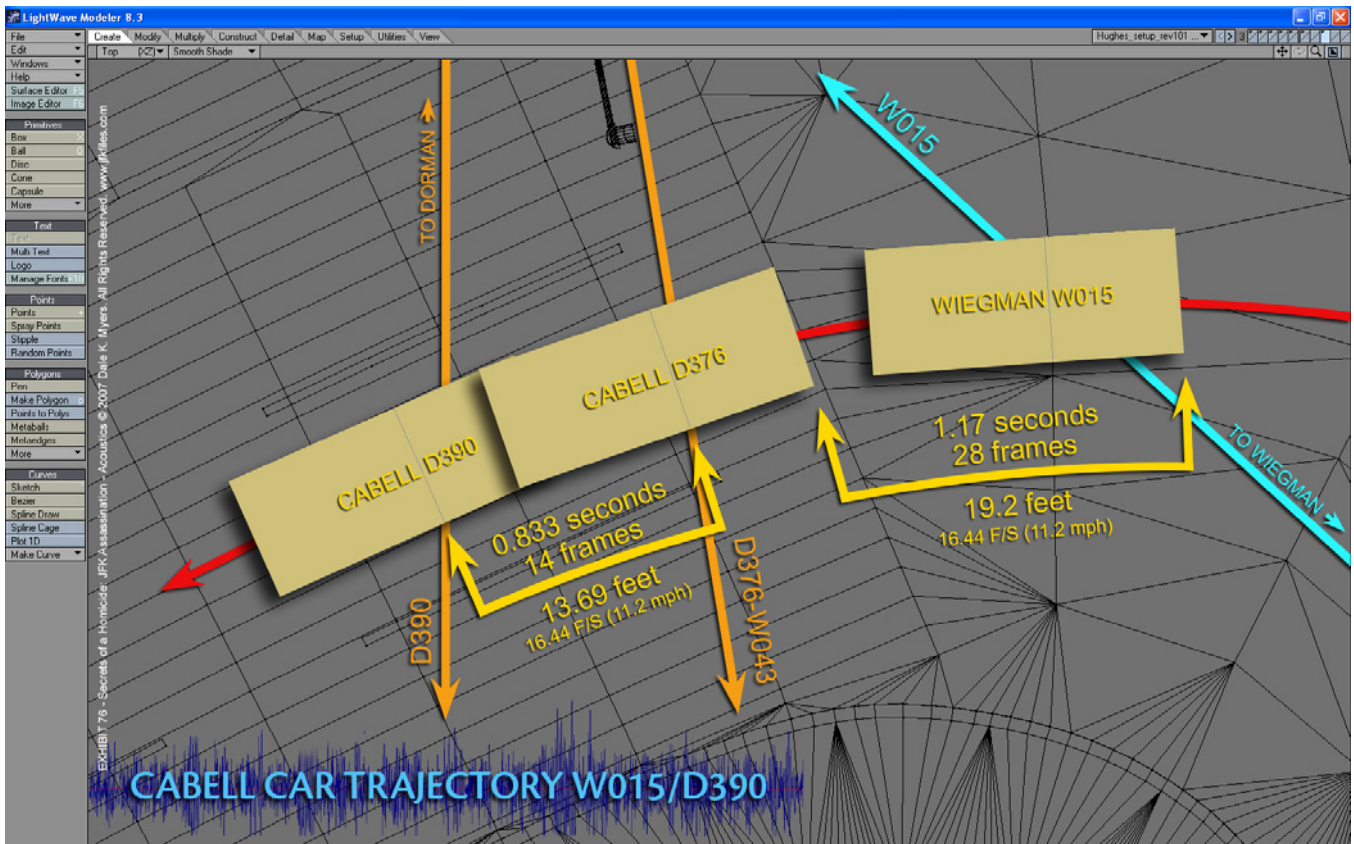


Exhibit 76. Plotting the distance traversed by Mayor Cabell's car between Wiegman W015 and Dorman D390.

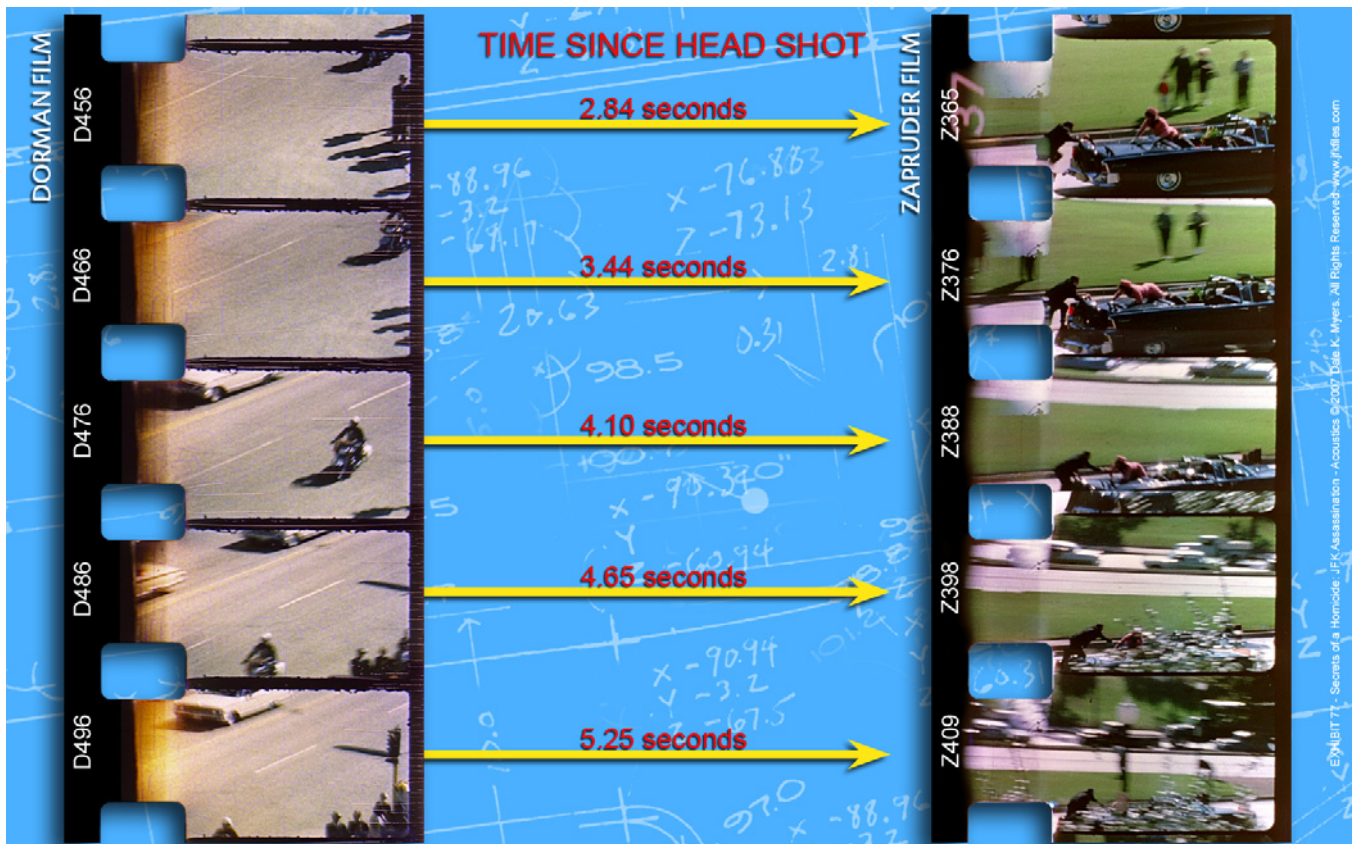


Exhibit 77. McLain's arrival at Elm and Houston synchronizes to a point after the head shot.

Since Wiegman frame W265 is the equivalent of Zapruder frame Z447, Wiegman-Dorman frame W043-D376 is the equivalent of Zapruder frame Z278. This was determined by taking the 222 total frame count between Wiegman W043 and W265 and dividing by 24 frames-per-second (the frame rate of Wiegman's camera) which yields a time period of 9.25 seconds. This time period equates to 169 Zapruder frames ($9.25 \times 18.3 = 169$). Subtracting 169 frames from Zapruder frame Z447 yields Zapruder frame Z278 ($447 - 169 = 278$). Therefore, Wiegman-Dorman frame W043-D376 is the equivalent of Zapruder frame Z278.

We can now compute the relationship between McLain's arrival at the corner of Elm and Houston, as depicted in Dorman sequence D456-D496, and the Zapruder film. The total frame count between Dorman frame D376 and D456 is 80 frames. Dividing the frame count by the Dorman camera speed yields a time period of 4.76 seconds ($80 \div 16.8 = 4.76$). This time period equates to 87 Zapruder frames ($4.76 \times 18.3 = 87$). Adding 87 frames to Zapruder frame Z278 (the equivalent of Dorman frame D376) equals Zapruder frame Z365. Therefore, Dorman frame D456, the first frame of the sequence depicting McLain's arrival at Elm and Houston, is the equivalent of Zapruder frame Z365. The final frame of the McLain arrival sequence, Dorman frame D496, likewise equates to Zapruder frame Z409.¹⁴⁵

145. Calculated as $(D496 - D456 = 40 \text{ frs} \div 16.8 \text{ fps} = 2.38 \text{ sec} \times 18.3 \text{ fps} = 44 \text{ frs} / Z365 + 44 \text{ frs} = Z409)$

In conclusion, the Dorman sequence D456-D496, depicting McLain's arrival at the corner of Elm and Houston, synchronizes to the period 2.84 to 5.25 seconds after the last shot; the equivalent of Zapruder frames Z365 to Z409. ^[Exhibit 77] Consequently, Robert Groden's claim that the Dorman sequence showed McLain arriving at the Elm and Houston corner at the time of the first shot – just as the acoustic evidence had predicted – is demonstratively false.

APPENDIX III

JFK ASSASSINATION AMATEUR FILM SYNCHRONIZATION TIMELINE

A synchronized timeline chart covering 49.29 seconds surrounding the assassination was assembled to show the relationship between the various amateur films used in this study. The vertical format displays each film in chronological order beginning 39.84 seconds before the fatal head shot and ending 9.45 seconds after the head shot. The frame rate of each camera is displayed under the name of the amateur photographer associated with each film clip. [Amateur Film Synchronization Timeline]

This timeline reflects all of the points of synchronization demonstrated in the previous appendices as well as all camera stops and film splices denoted in the film breakdown that follows the chart. The error ratio of this analysis is +/- one frame.

AMATEUR FILM SYNCHRONIZATION TIMELINE

EPIPOLAR GEOMETRIC ANALYSIS OF AMATEUR FILMS RELATED TO ACOUSTICS EVIDENCE IN THE JOHN F. KENNEDY ASSASSINATION

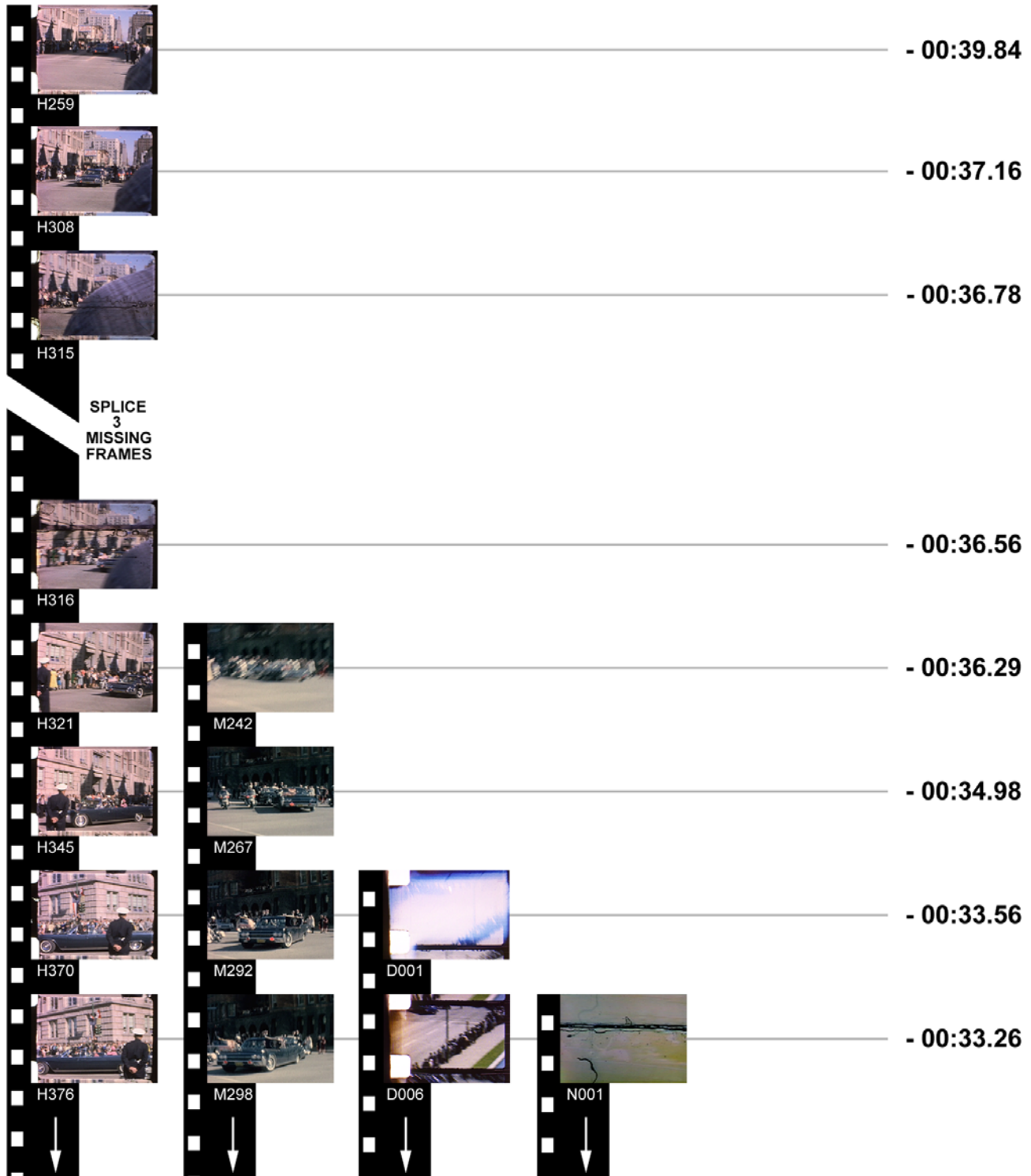
HUGHES
18.3





















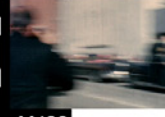








MUCHMORE
18.5

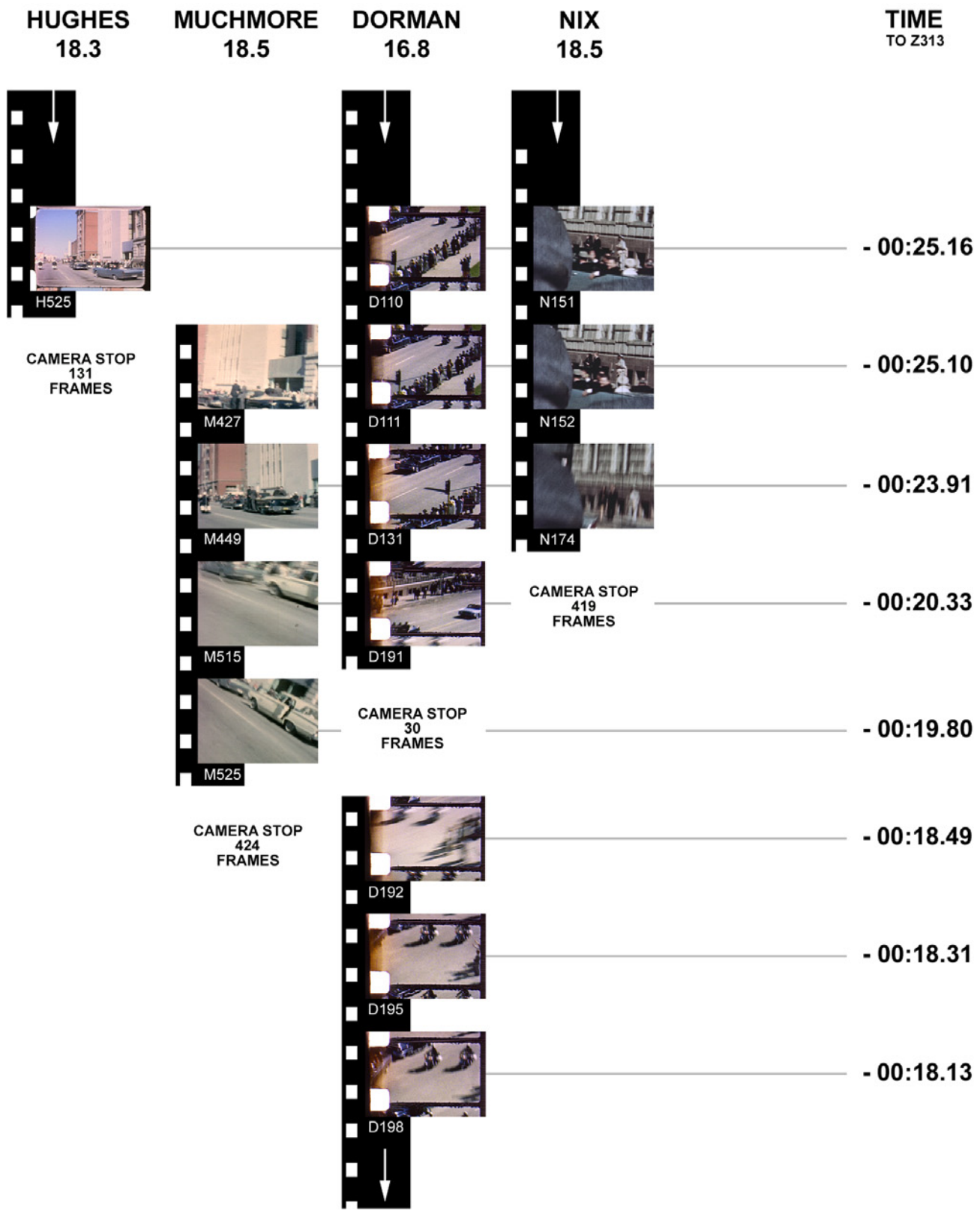
DORMAN
16.8

NIX
18.5

TIME
TO Z313



| HUGHES 18.3 | MUCHMORE 18.5 | DORMAN 16.8 | NIX 18.5 | TIME TO Z313 |
|---|---|---|--|-----------------|
|  H388 |  M310 |  D017 |  N013 | - 00:32.63 |
|  H415 |  M338 |  D042 |  N040 | - 00:31.15 |
|  H418 |  M341 |  D045 |  N044 | - 00:30.96 |
|  H437 |  M360 | CAMERA STOP 32 FRAMES |  N063 | - 00:29.95 |
|  H455 |  M378 |  D046 |  N081 | - 00:28.97 |
|  H502 |  M426 |  D089 |  N129 | - 00:26.39 |
|  H510 | CAMERA STOP 23 FRAMES |  D096 |  N136 | - 00:25.99 |
|  H516 | |  D102 |  N143 | - 00:25.63 |



HUGHES
18.3

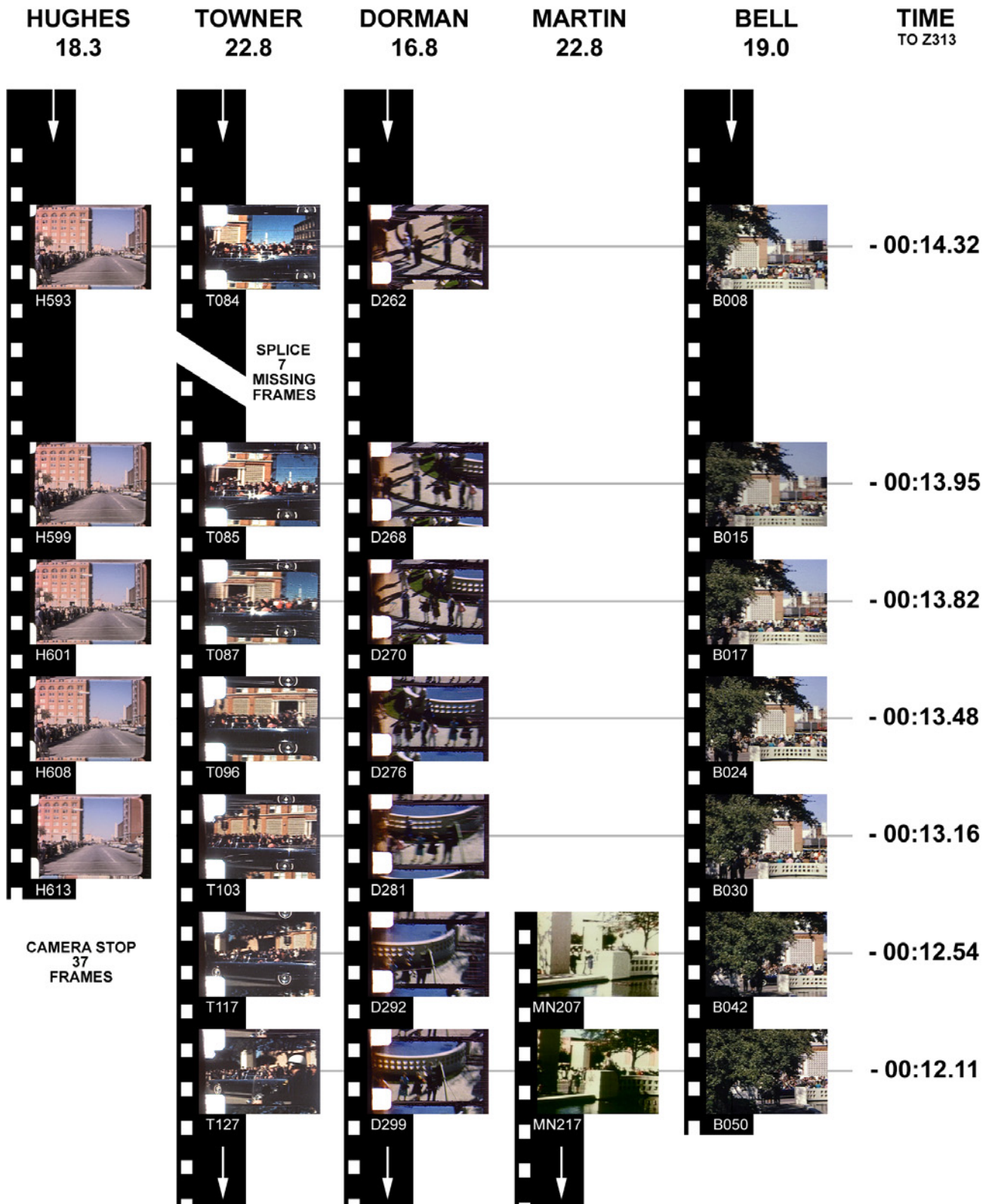
TOWNER
22.8

DORMAN
16.8

BELL
19.0

TIME
TO Z313





HUGHES
18.3

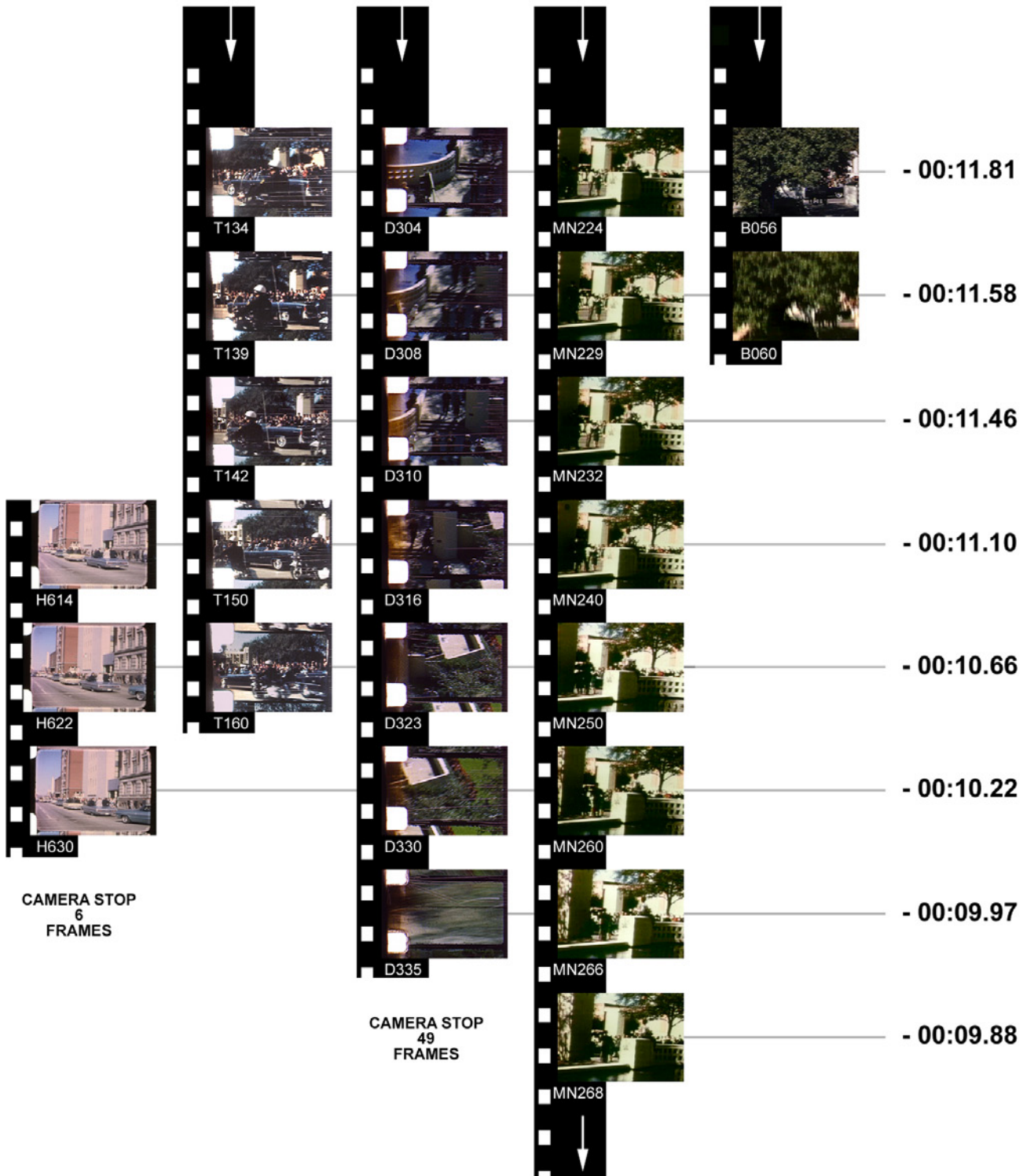
TOWNER
22.8

DORMAN
16.8

MARTIN
22.8

BELL
19.0

TIME
TO Z313

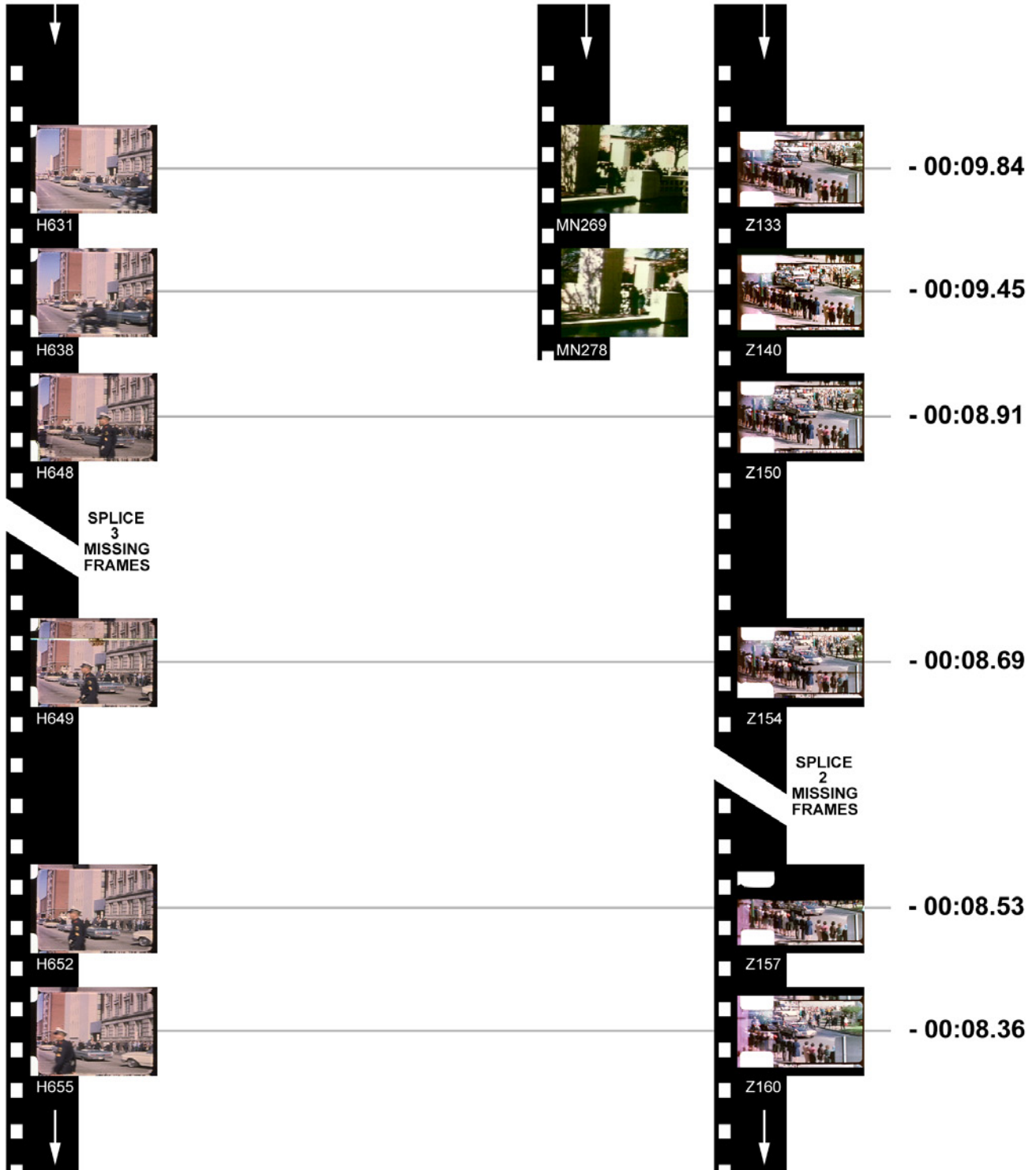


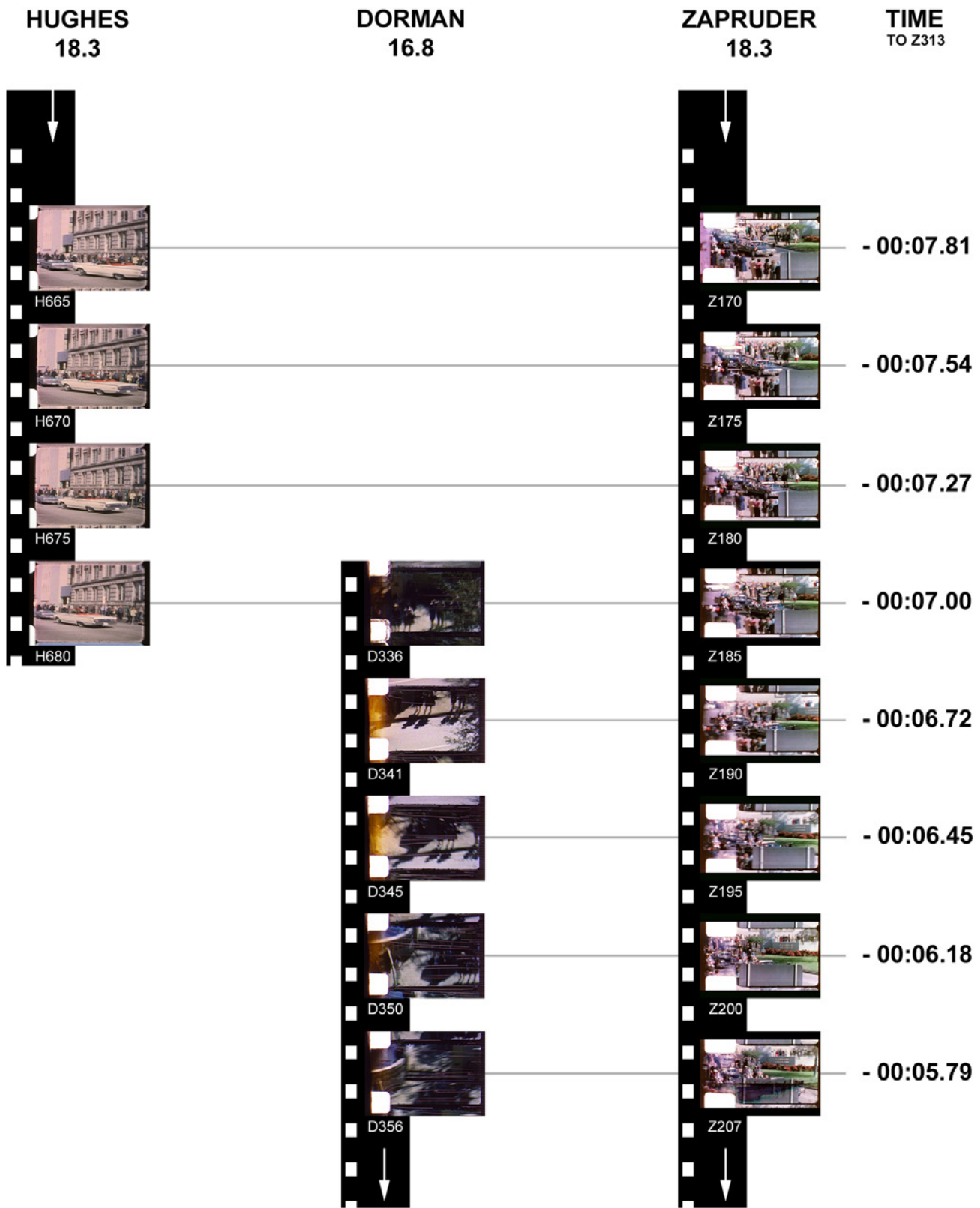
HUGHES
18.3

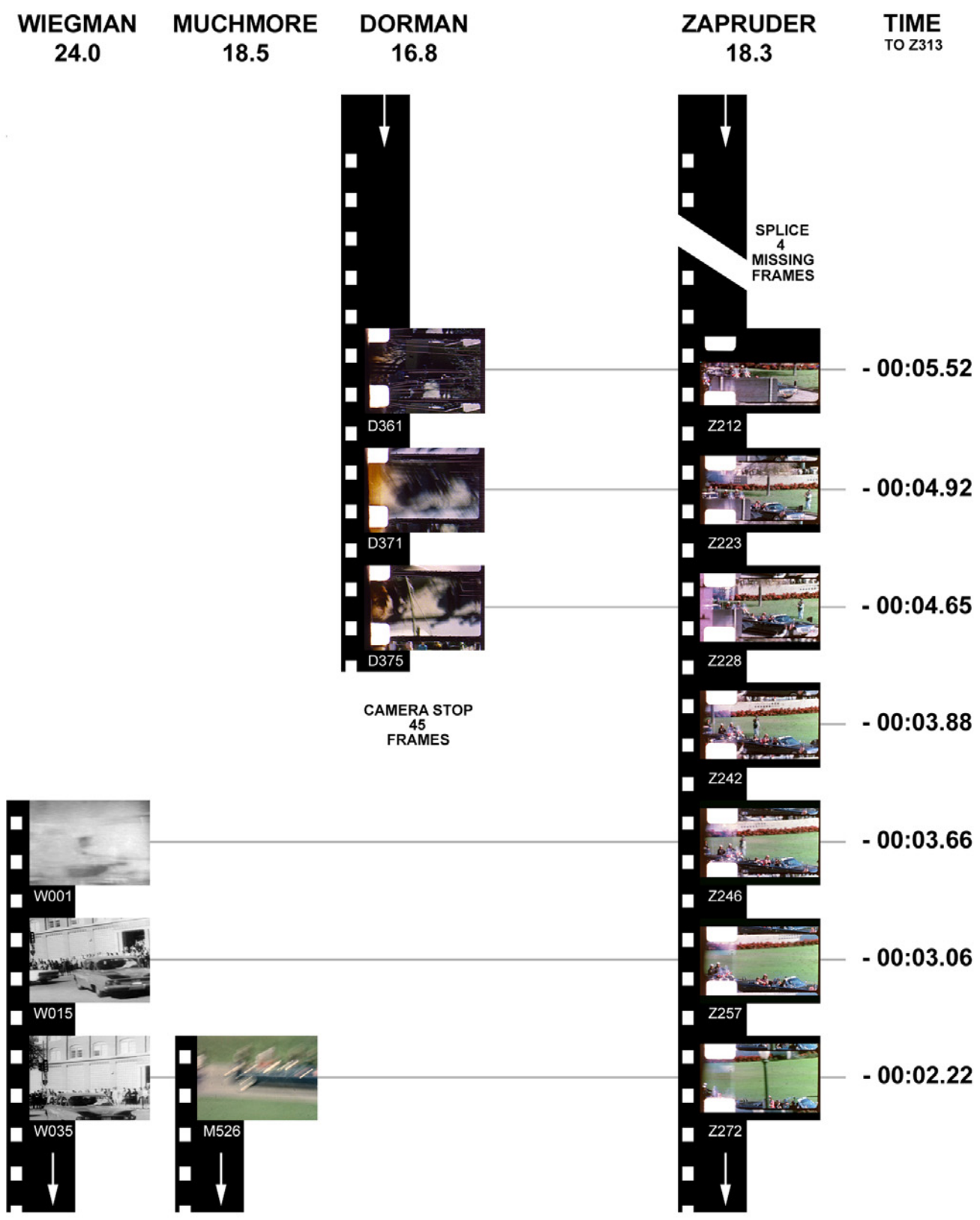
MARTIN
22.8

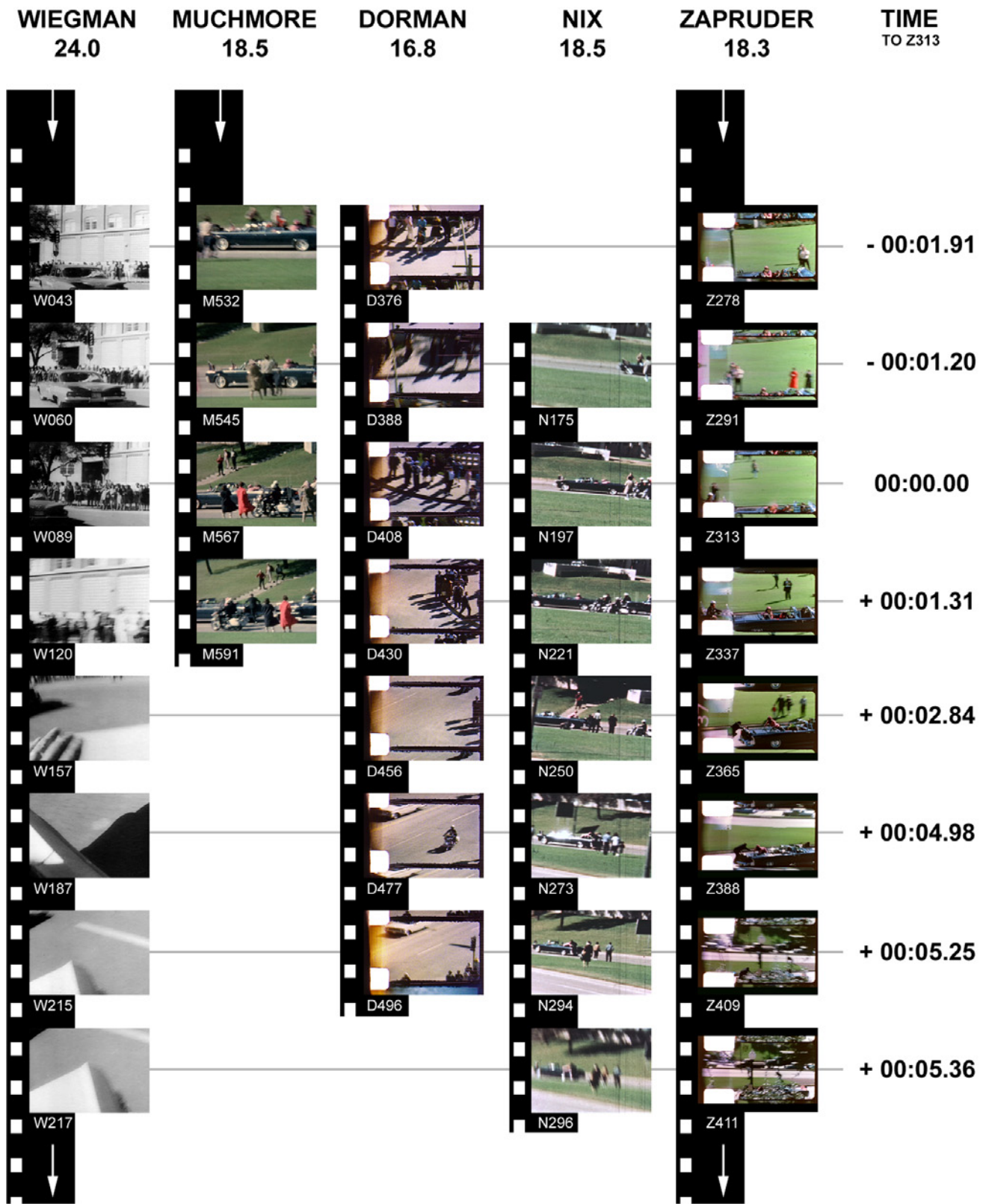
ZAPRUDER
18.3

TIME
TO Z313





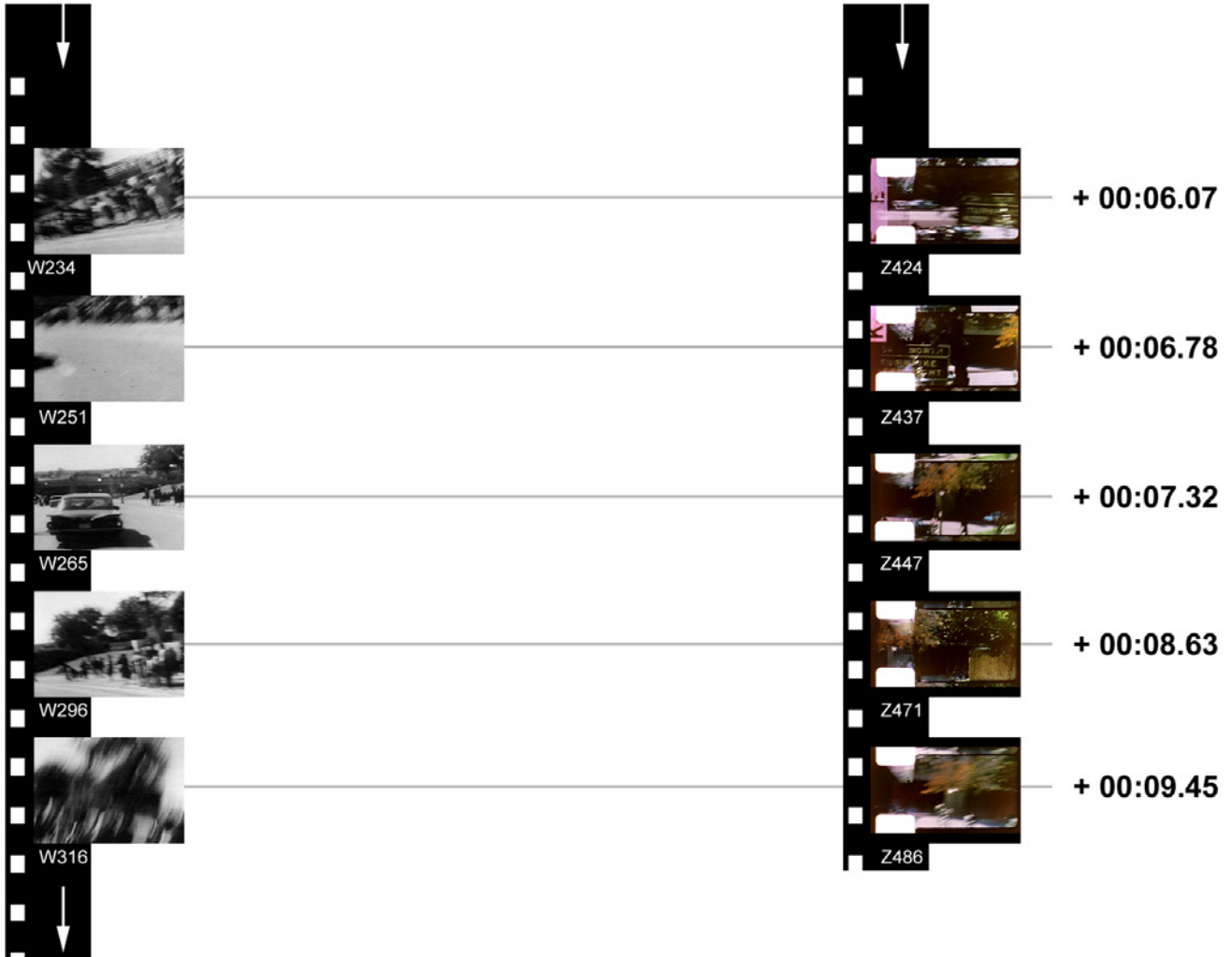




WIEGMAN
24.0

ZAPRUDER
18.3

TIME
TO Z313



(SEC-1) Robert Hughes Film – Camera Frame Rate: 18.3 fps

The Robert Hughes film consists of 18 sequences, 8 pre-assassination and 10 post assassination scenes. Sequence 5 is the first that depicts the presidential limousine, which appears on Main Street, approaching the Houston Street corner. Sequences 6, 7 and 8 depict the limousine as it turns from Main onto Houston, travels north on Houston, and turns onto Elm Street. These three sequences encompass frames H259 through H680 and are spread across a time period of 32.84 seconds; beginning 39.84 seconds before the fatal head shot and ending 7.0 seconds before the head shot. The frame rate of the Hughes camera, relative to Zapruder's camera, was determined to be 18.3 frames-per-second. There are 3 camera stops and 2 splices between Hughes frames H259-H680:

H315-H316 Splice (3 frames missing)

Three frames were found to be missing at the point of a film splice between Hughes frames H315-H316. This was determined by comparing the progression of the limousine shadow in relation to the crosswalk at Main and Houston Streets during the frame sequences immediately before and after the splice with the progression of the limousine shadow between frames H315-H316. The result shows 3 frames to be missing between H315-H316. [Exhibit 78]

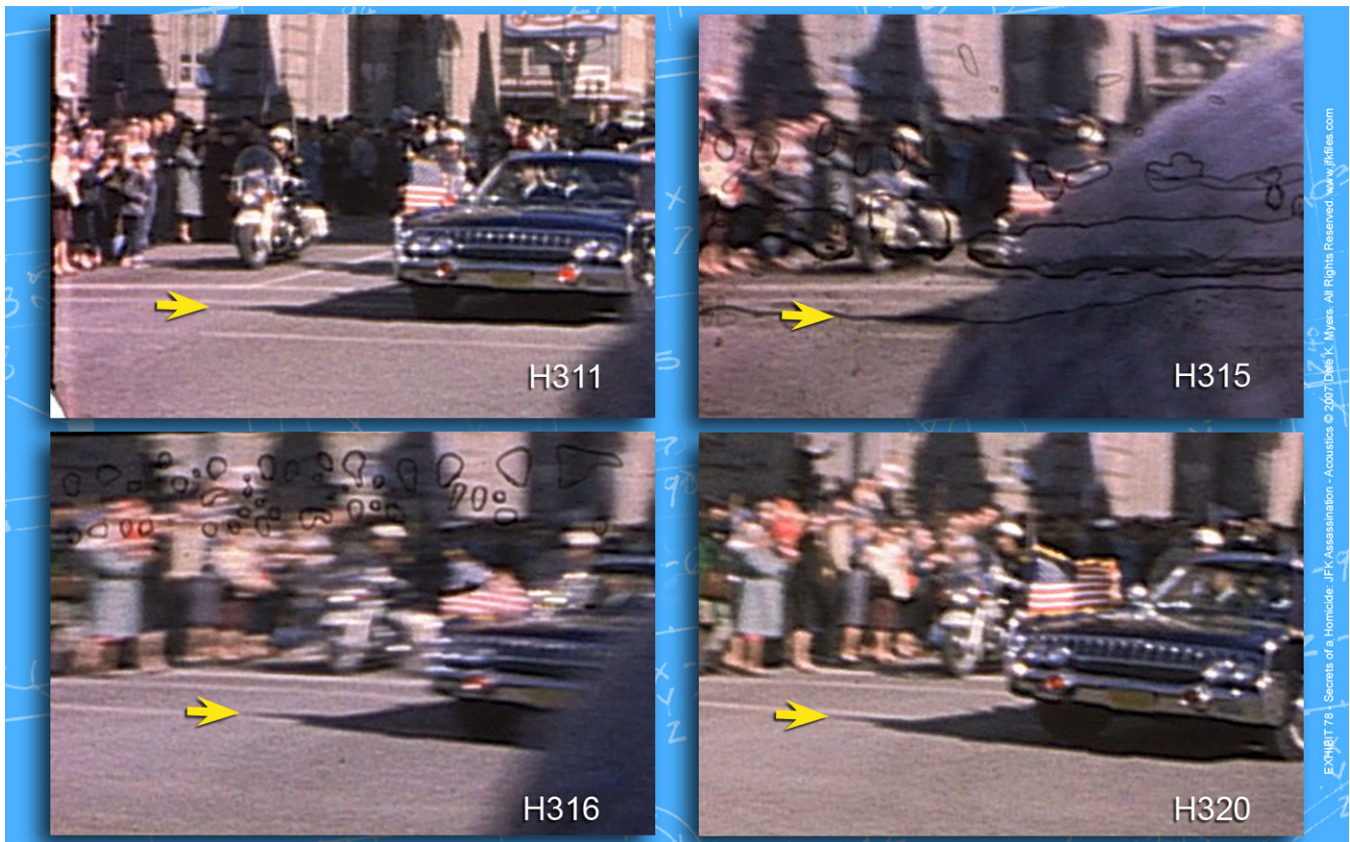


Exhibit 78. Progression of limousine shadow shows 3 frames missing between Hughes frames H315-H316.



Exhibit 79. Relationship of road stripes to limousine shows Dorman D204 equates to Hughes H529.

H525-H526 (131 frame camera stop)

The camera was stopped for a period of 131 frames between Hughes frames H525-H526. The camera stops are easily identified in all films by a break in the action accompanied by a single, slightly over exposed frame (the result of the camera mechanism taking a fraction of a second to reach operating speed, thereby causing the first frame to be exposed to light longer than normal) marking the beginning of the sequence that follows the camera stop. In this instance, restart frame H526 was slightly overexposed. The total length of the stoppage was determined by synchronizing the restart frame to the Dorman film and calculating the offset period. Hughes sequence H526-H535 depicts the presidential limousine turning from Houston onto Elm Street. Dorman sequence D201-D209 also depicts the limousine during this same period. By comparing the relationship of the limousine to the left lane road stripes, it was determined that Hughes frame H529 was the equivalent of Dorman frame D204. Hughes frame H526 (the restart frame) was therefore exposed 17.93 seconds before the head shot. Since Hughes frame H525 was exposed 25.16 seconds before the head shot and Hughes frame H526 was exposed 17.93 seconds before the head shot, then 7.23 seconds elapsed between the two exposures. Hence, the camera was stopped for 7.18 seconds ($7.23 - 0.055$ [1 frame] = 7.18) which equates to 131 frames. ($7.18 \times 18.3 = 131$) [Exhibit 79]

H613-H614 (37 frame camera stop)

The camera was stopped for a period of 37 frames between Hughes frames H613-H614. Frame H614 was slightly overexposed, indicating the camera restart. The total length of the stoppage was determined by synchronizing the 2.19 second sequence encompassing Hughes frames H614 through H648 with the Zapruder film and calculating the offset period between Hughes frame H613 and H614. As demonstrated earlier, Hughes frame H648 synchronizes to Zapruder frame Z150. Since Zapruder frame Z150 was exposed 8.91 seconds before the head shot and Hughes sequence H614 through H648 is 2.19 seconds in length, then Hughes frame H614 was exposed 11.10 seconds ($8.91 + 2.19 = 11.10$) before the head shot. Since the Hughes frame H613 was exposed 13.16 seconds before the head shot and Hughes frame H614 was exposed 11.10 seconds before the head shot, then 2.06 seconds elapsed between the two exposures. Hence, the camera was stopped for 2.01 seconds ($2.06 - 0.055 [1 \text{ frame}] = 2.01$) which equates to 37 frames. ($2.01 \times 18.3 = 37$)

These calculations are consistent with the relative speed of the motorcade. This can be demonstrated by examining the trajectory and speed of the National Press Pool Car, the ninth car in the motorcade, during this period:

(a) The National Press Pool Car's speed immediately prior to Hughes frame H613 was calculated to be 11.44 feet/second (7.8 mph).

The National Press Pool Car was a 1960 Chevrolet Bel Air which had an overall length of 210.8 inches (17.6 feet).¹⁴⁶ The National Press Pool Car was found to traverse its own overall length (17.6 feet) between Hughes frames H577-H605 – a total of 28 frames. Dividing the speed of the Hughes camera (18.3 frames/second) into the frame count yields a time of 1.53 seconds. This calculates to a speed of 11.50 feet/second (7.8 mph). [Exhibit 80]

(b) The National Press Pool Car's speed between Zapruder frames Z185-Z207 was calculated to be 14.67 feet/second (9.9 mph).

An enlarged and stabilized Zapruder film sequence was created for this analysis. The National Press Pool Car appears above the concrete wall in the background of Zapruder sequence Z185-207. During that period, the National Press Pool Car traverses its own overall length of 17.6 feet in 22 frames. Dividing the speed of the Zapruder camera (18.3 frames/second) into the frame count yields a time of 1.2 seconds. This calculates to a speed of 14.67 feet/second (9.9 mph) [Exhibit 81]

146. Gunnell, John, *Standard Catalog of American Cars, 1946-1975, Revised 4th Edition*, Krause Publications, 2002, p.172

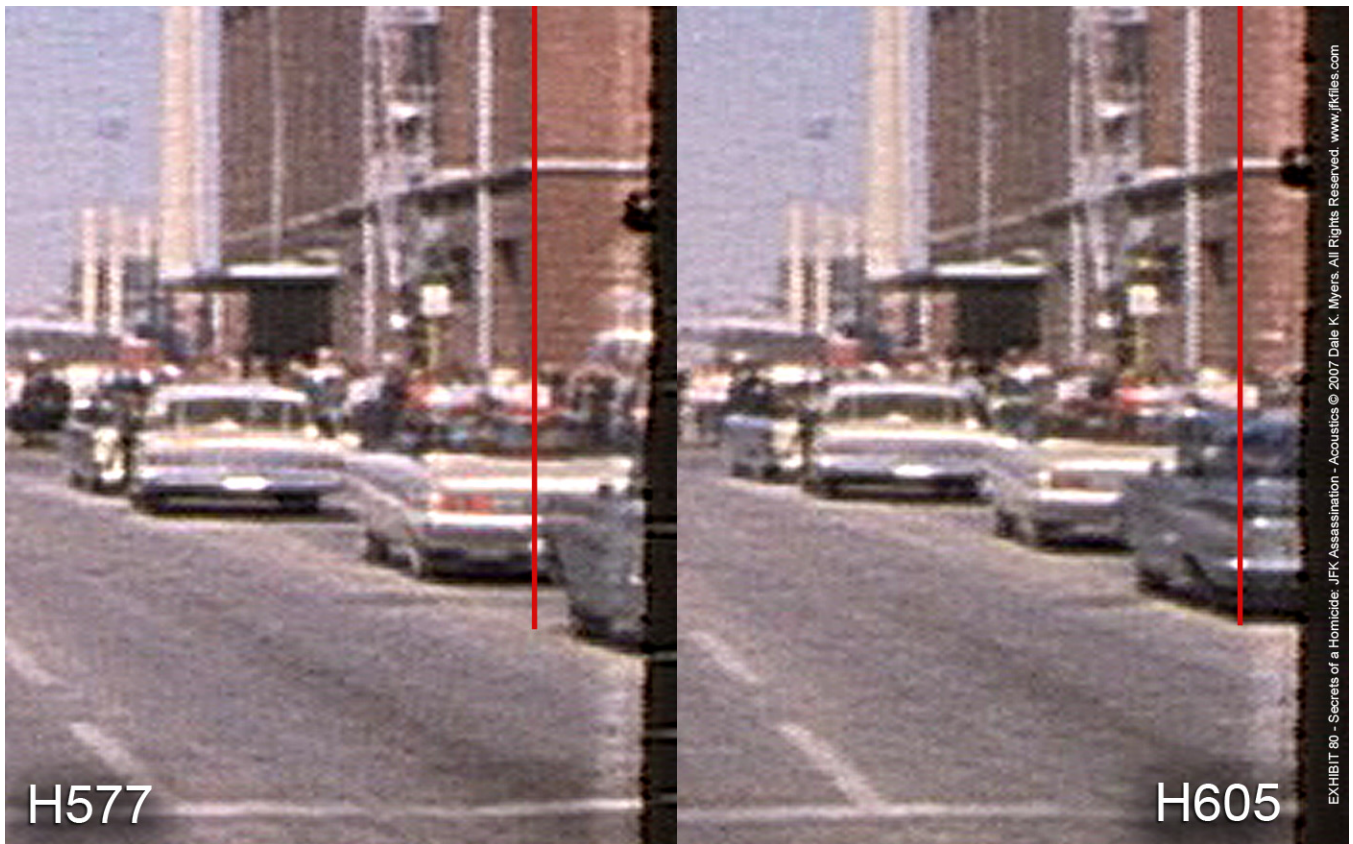


EXHIBIT 80 - Secrets of a Homicide: JFK Assassination - Acoustics © 2007 Dale K. Myers. All Rights Reserved. www.jfkfiles.com

Exhibit 80. Plotting the speed of the National Press Pool Car between Hughes frames H577 and H605.

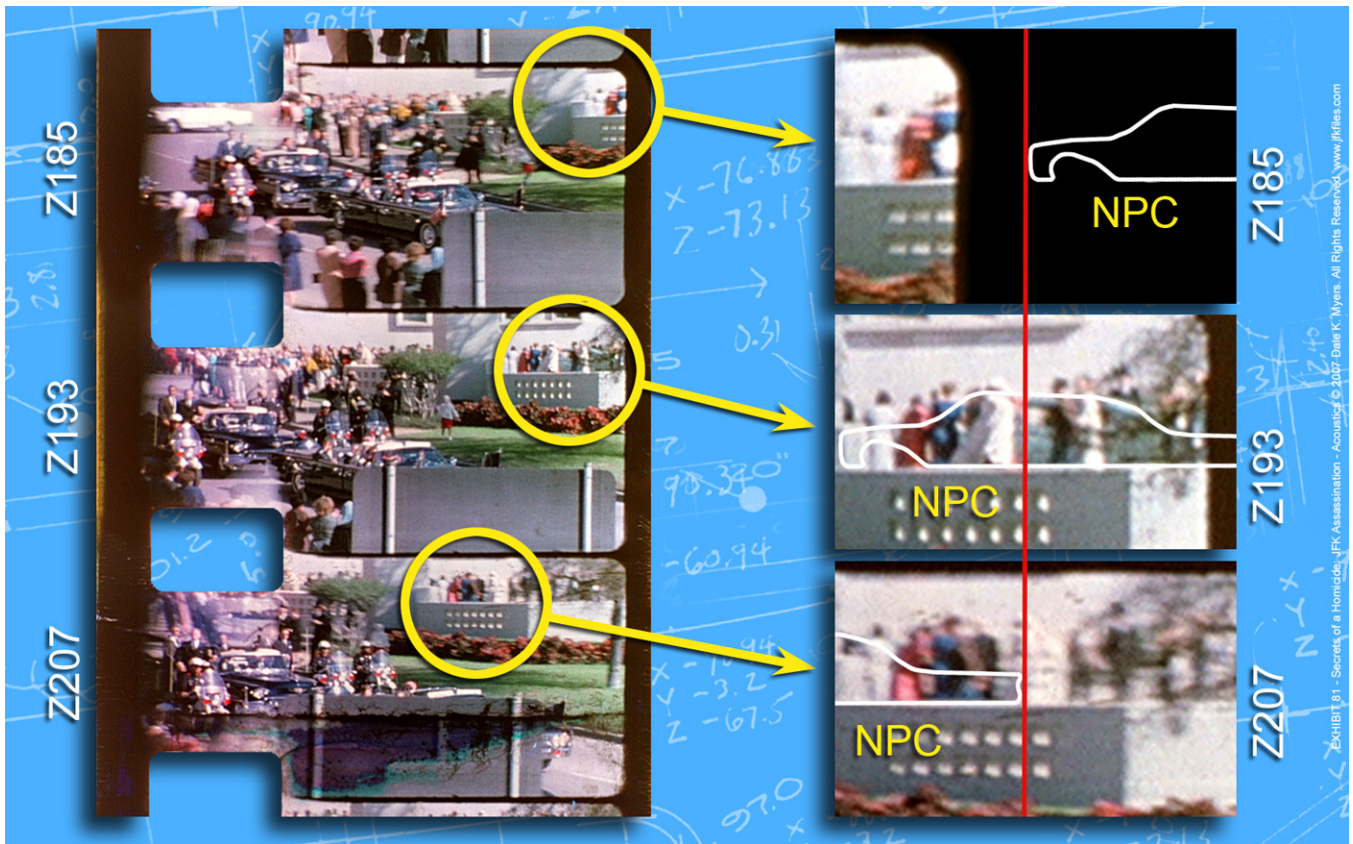


EXHIBIT 81 - Secrets of a Homicide: JFK Assassination - Acoustics © 2007 Dale K. Myers. All Rights Reserved. www.jfkfiles.com

Exhibit 81. Plotting the speed of the National Press Pool Car between Zapruder frames Z185 and Z207.



Exhibit 82. Plotting the position of the National Press Pool Car at Hughes frames H613 and H614.

(c) A computer model of the position of the National Press Pool Car at Hughes frames H613 and H614 shows that it traverses a distance of 24 feet.

A computer model of the National Press Pool Car was positioned to match Hughes frame H613 by noting the vehicle's relationship to a line-of-sight drawn between Hughes' camera and the southwest corner of the Dal-Tex Building. A computer model of the National Press Pool Car was also positioned to match Hughes frame H614 by noting the vehicle's relationship to that same line-of-sight. ^[Exhibit 82] The distance between these two positions (rear bumper-to-rear bumper) was measured at 24 feet.

(d) The National Press Pool Car would have traversed the 24 feet between Hughes frame H613 and H614 in 2.06 seconds traveling at an estimated speed of 11.65 feet/second (7.9 mph).

The estimated speed of the National Press Pool Car during this period was an average speed based on the synchronization of Hughes frames H613 and H614 as described above. Since the Hughes frame H613 was exposed 13.16 seconds before the head shot and Hughes frame H614 was exposed 11.10 seconds before the head shot, then 2.06 seconds elapsed between the two exposures. Dividing the distance of 24 feet by the time period of 2.06 seconds yields an estimated speed of 11.65 feet/second (7.9 mph). ^[Exhibit 83]

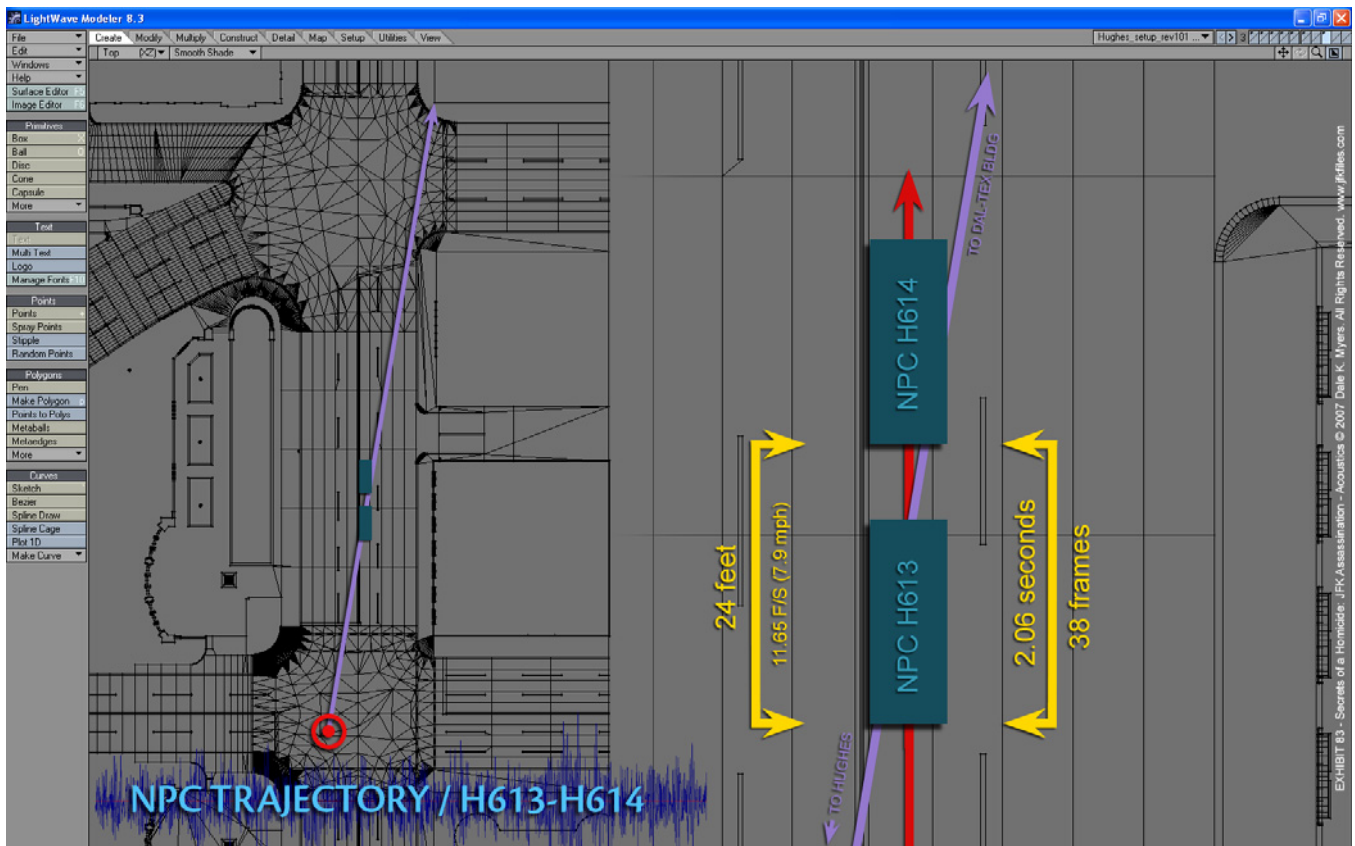


Exhibit 83. Plotting the distance traversed by the National Press Pool Car between Hughes H613 and H614.

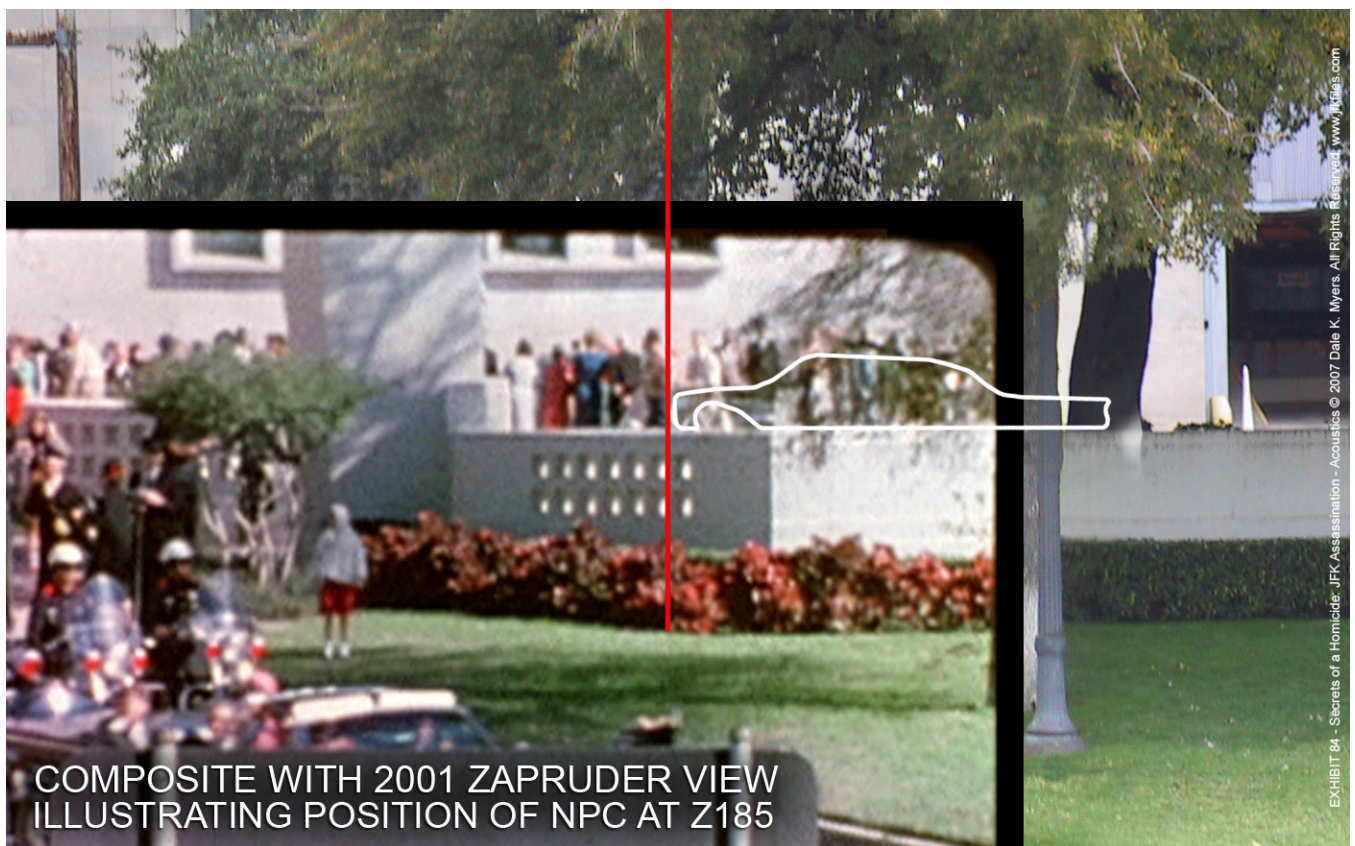


Exhibit 84. Composite image depicting the position of the National Press Pool Car at Zapruder frame Z185.

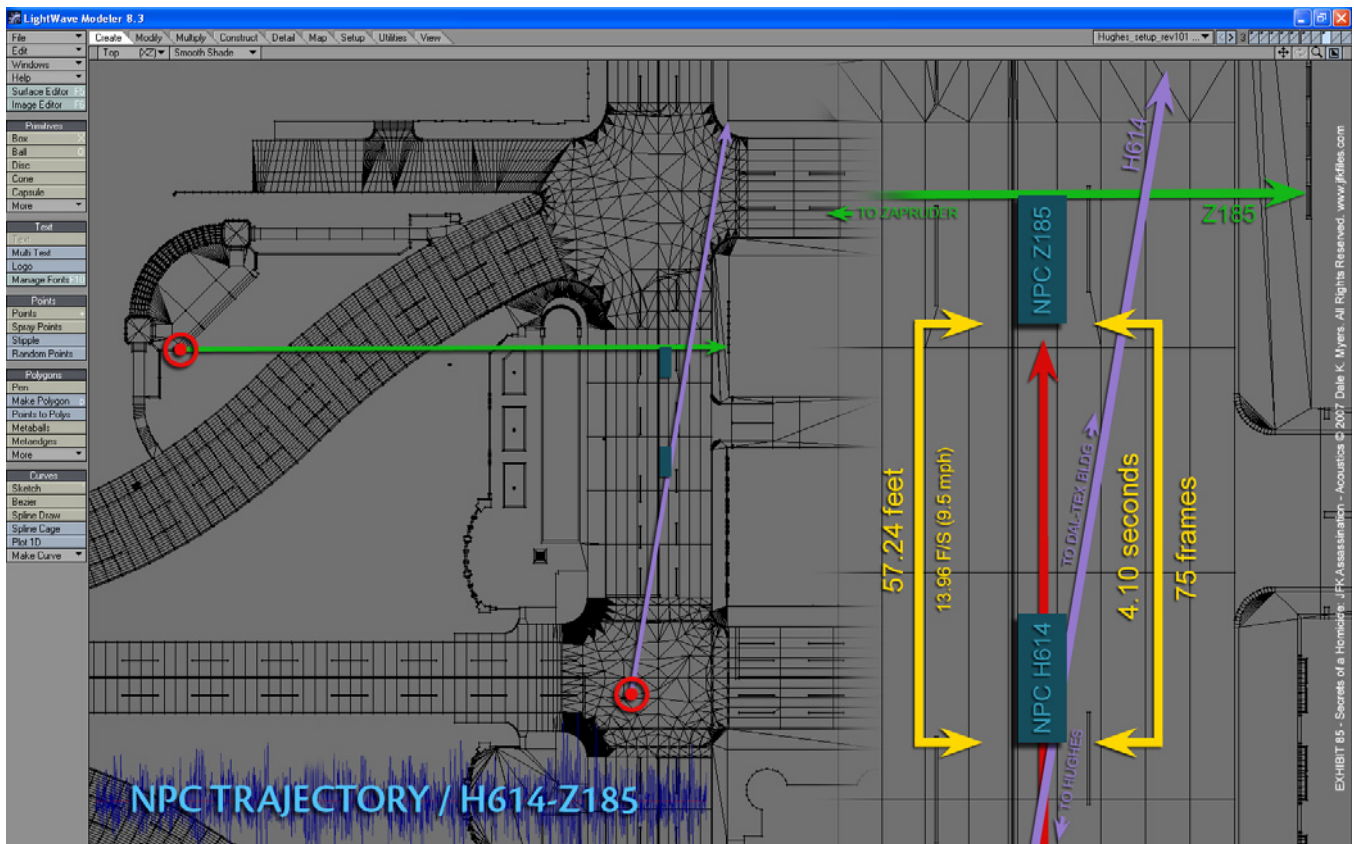


Exhibit 85. Plotting the position of the National Press Pool Car at Hughes frames H613 and H614.

(e) A computer model of the position of the National Press Pool Car at Hughes frame H614 and Zapruder frame Z185 shows that it traverses a distance of 57.24 feet.

A computer model of the National Press Pool Car was positioned to match Hughes frame H614. [See (c) above] A computer model of the National Press Pool Car was also positioned to match Zapruder frame Z185 by noting the vehicle's relationship to a line-of-sight drawn between Zapruder's camera and the windows on the west wall of the Records Building. [Exhibit 84] The distance between these two positions (rear bumper-to-rear bumper) was measured at 57.24 feet.

(f) The National Press Pool Car would have traversed the 57.24 feet between Hughes frame H614 and Zapruder frame Z185 in 4.10 seconds traveling at an estimated speed of 13.96 feet/second (9.5 mph).

The estimated speed of the National Press Pool Car during this period was an average speed based on the synchronization of Hughes frame H614 as described above. Since the Hughes frame H614 was exposed 11.10 seconds before the head shot and Zapruder frame Z185 was exposed 7.0 seconds before the head shot, then 4.10 seconds elapsed between the two exposures. Dividing the distance of 57.24 feet by the time period of 4.10 seconds yields an estimated speed of 13.96 feet/second (9.5 mph). [Exhibit 85]

The above calculations show the National Press Pool Car traveling at speeds consistent with the relative speed of the motorcade as it traveled north on Houston Street - 7.8 mph (H577-H605), 7.9 mph (H613-H614), 9.5 mph (H614-Z185) and 9.9 mph (Z185-Z207).

In conclusion, the six calculations above demonstrate that a 37 frame camera stop between Hughes frames H613-H614 maintains the trajectory and speed of the National Press Pool Car on Houston Street and is consistent with the known relative speed of the motorcade procession.

H630-H631 (6 frame camera stop)

The camera was stopped for a period of 6 frames between Hughes frames H630-H631. Frame H631 was slightly overexposed, indicating the camera restart. The total length of the stoppage was determined by comparing the progression of Camera Car 3 between Hughes frames H623-H630 with the progression of Camera Car 3 between Hughes frames H630-H631. Using lines-of-sight projected between the Hughes camera and objects in the background, it can be seen that Camera Car 3 traverses the same distance between Hughes frames H623-H630 as it does between Hughes frames H630-H631. Since the elapsed time between Hughes frames H623-H630 is 7 frames, the length of the estimated camera stoppage between Hughes frames H630-H631 is 6 frames. ^[Exhibit 86]

H648-H649 Splice (3 frames missing)

Three frames were found to be missing at the point of a film splice between Hughes frames H648-H649. This was determined by comparing the progression of Dallas police officer D.V. Harkness as he crosses the frame. The result shows 3 frames to be missing between H648-H649. ^[Exhibit 87]

(SEC-2) Marie Muchmore Film – Camera Frame Rate: 18.5 fps

The Marie Muchmore film consists of 7 sequences; 6 pre-assassination, and 1 during the shooting. Sequence 5 is the first that depicts the presidential limousine, which appears turning from Main onto Houston Street. Sequence 6 depicts the limousine heading north on Houston followed by the Vice Presidential Car and the Vice Presidential Secret Service Follow-Up Car. Sequence 7 depicts the presidential limousine on Elm street during the shooting and is the equivalent of Zapruder frames Z272 through Z337. These last three sequences encompass frames M242 through M591 and are spread across a time period of 37.6 seconds; beginning 36.29 seconds before the fatal head shot and ending 1.31 seconds after the head shot. The frame rate of the Muchmore camera was determined by the FBI to be 18.5 frames-per-second. There are 2 camera stops between Muchmore frames M242-M591:

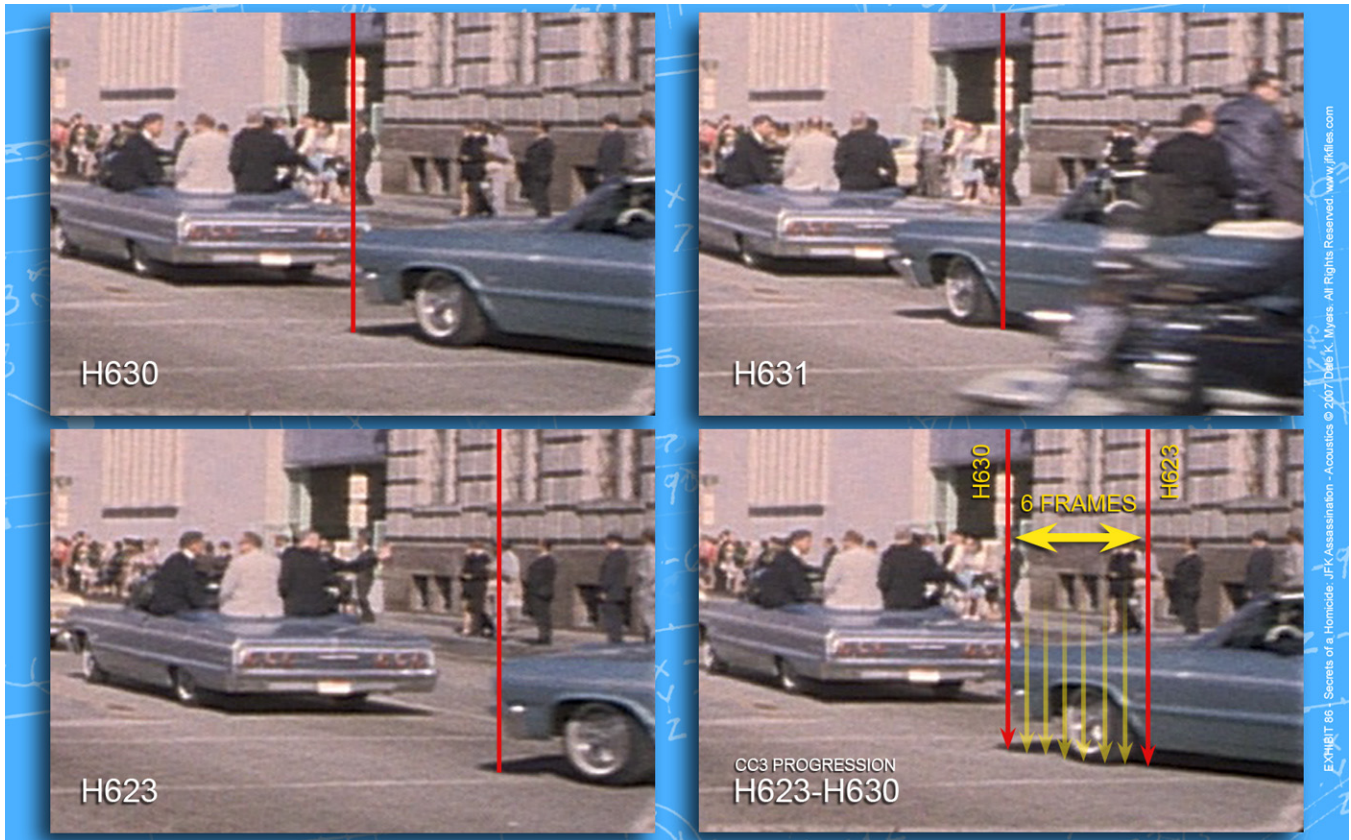


Exhibit 86. The progression of Camera Car 3 shows a camera stop of 6 frames between Hughes H630-H631.

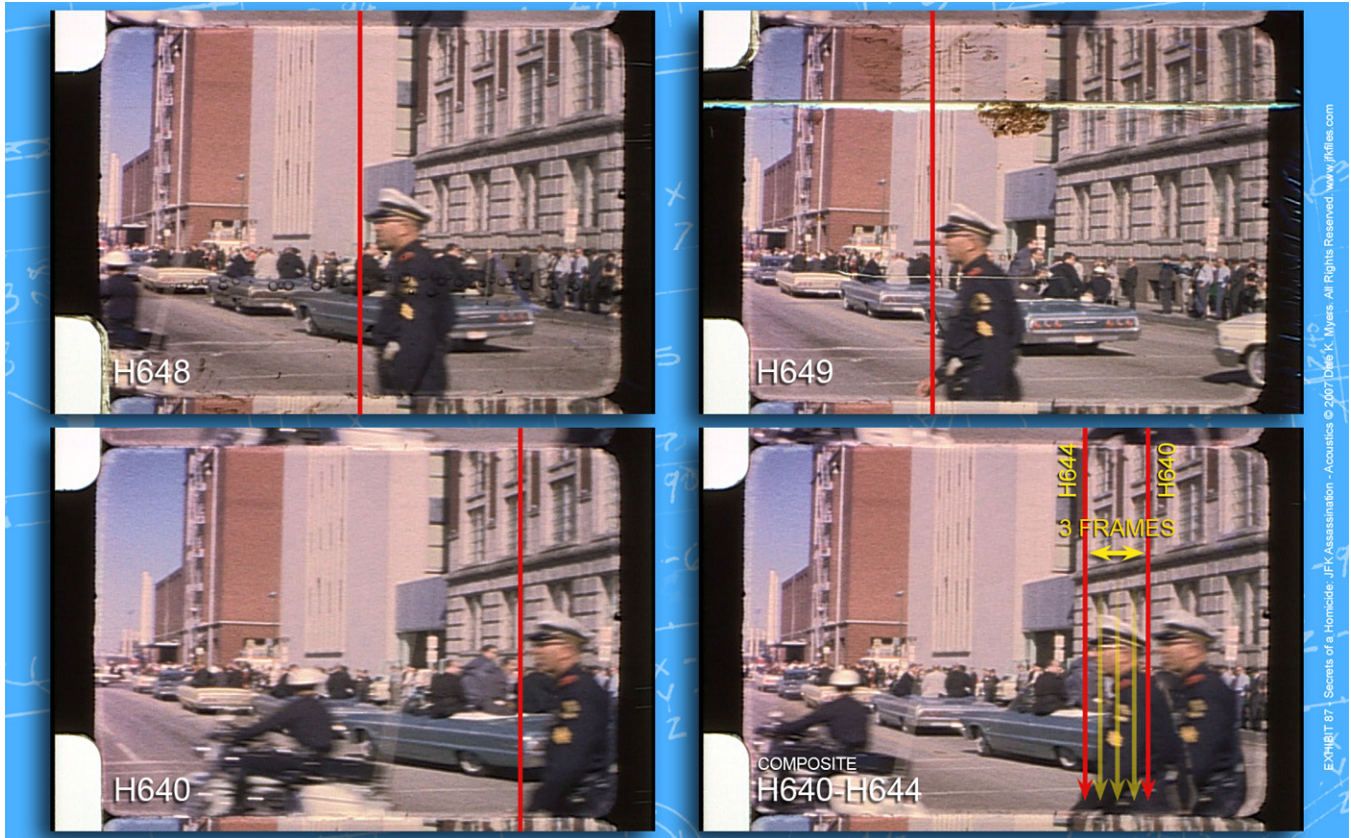


Exhibit 87. The progression of Officer D.V. Harkness shows 3 frames missing at the H648-H649 splice.

M426-M427 (23 frame camera stop)

The camera was stopped for a period of 23 frames between Muchmore frames M426-M427. Frame M427 was slightly overexposed, indicating the camera restart. The total length of the stoppage was determined by synchronizing the restart frame to the Dorman film and calculating the offset period. An examination of four films demonstrates:

(a) Muchmore frame M426 was found to have been exposed 26.39 seconds before the head shot.

Texas Governor John B. Connally can be seen lifting his hand in a wave in the Muchmore, Hughes, and Nix films as the limousine traverses the crosswalk on Houston at Main. By comparing the position of Connally's hand as depicted in these three films, it was determined that Muchmore frame M338 was the equivalent of Nix frame N040 and Hughes frame H415. ^[Exhibit 88] These three frames synchronize to a moment 31.15 seconds before the head shot. The offset period between Muchmore frame M338 and M426 is 4.76 seconds ($426 - 338 = 88 \div 18.5 \text{ fps} = 4.76$), which demonstrates that Muchmore frame M426 was exposed 26.39 seconds ($31.15 - 4.76 = 26.39$) before the head shot.

(b) Muchmore frame M427 was found to have been exposed 25.10 seconds before the head shot.

A computer model of the presidential limousine was positioned to match Muchmore frame M427 by noting the vehicle's relationship to two lines-of-sight drawn between Muchmore's camera and the northwest corner of the Dallas Records Building, as well as to the windows on the west wall of the Dallas Records Building. A line-of-sight was then plotted on the computer model between the Dorman camera and the left-front red flasher of the presidential limousine. That line was then extended until it intersected the west wall of the Dallas County Courthouse Building. ^[Exhibit 89] To determine the specific Dorman frame which corresponds to Muchmore frame M427, a composite mosaic image was created from multiple Dorman frames. A red line matching the computer plotted line-of-sight between the Dorman camera and the west wall of the Dallas County Courthouse was superimposed onto the mosaic image. A sequence of Dorman frames was then superimposed onto the mosaic image until a frame was found that matched the computer plotted position of the limousine. It was determined that Dorman frame D111, which was exposed 25.10 seconds before the head shot, was the equivalent of Muchmore M427. ^[Exhibit 90]

Since Muchmore frame M426 was exposed 26.39 seconds before the head shot and Muchmore frame M427 was exposed 25.10 seconds before the head shot, then 1.29 seconds elapsed between the two exposures. Hence, the camera was stopped for 1.24 seconds ($1.29 - 0.054 [1 \text{ frame}] = 1.24$) which equates to 23 frames ($1.24 \times 18.5 = 23$).



Exhibit 88. Governor Connally's wave synchronizes Muchmore M338 to Nix N040 and Hughes H415.

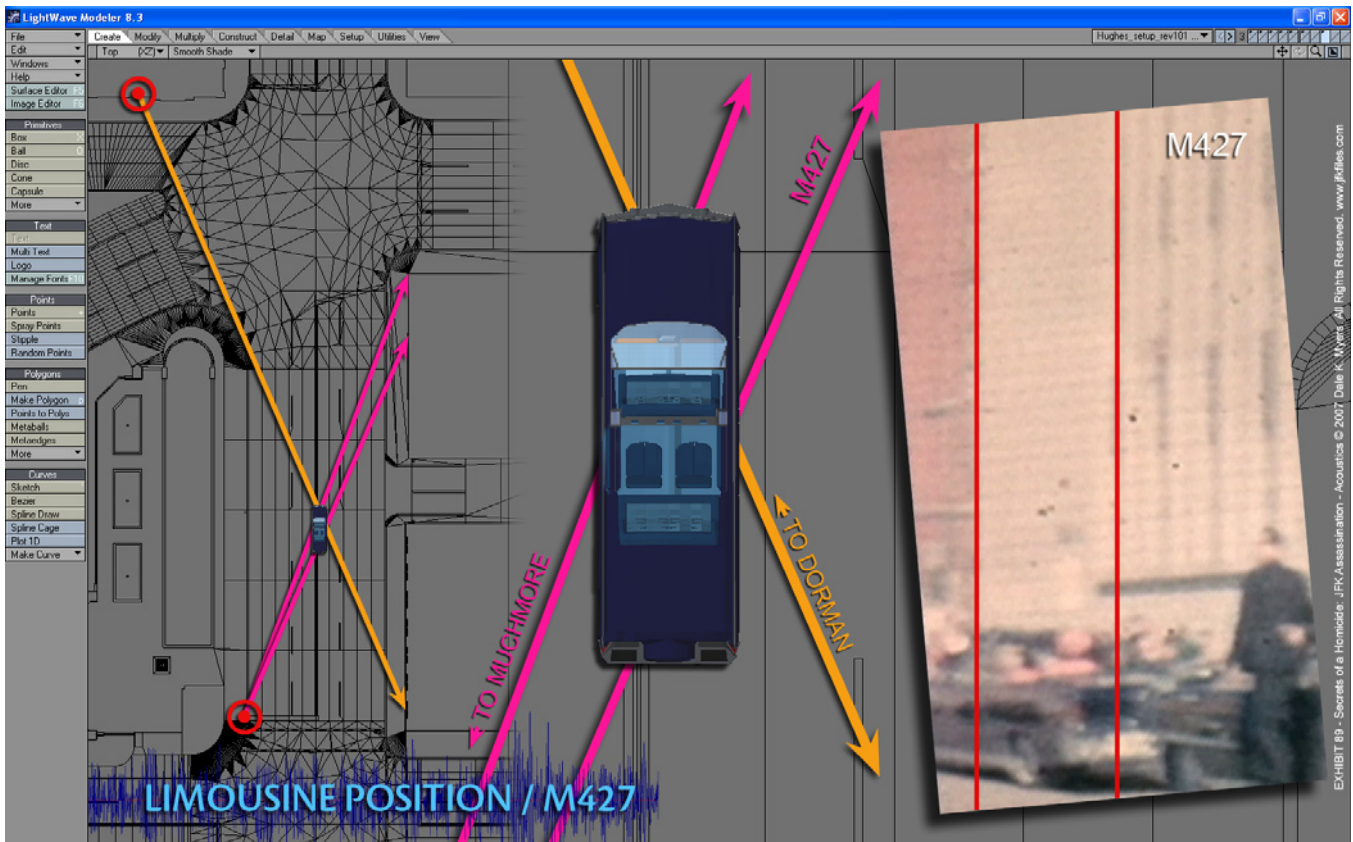


Exhibit 89. Plotting the position of the presidential limousine at Muchmore frame M427.

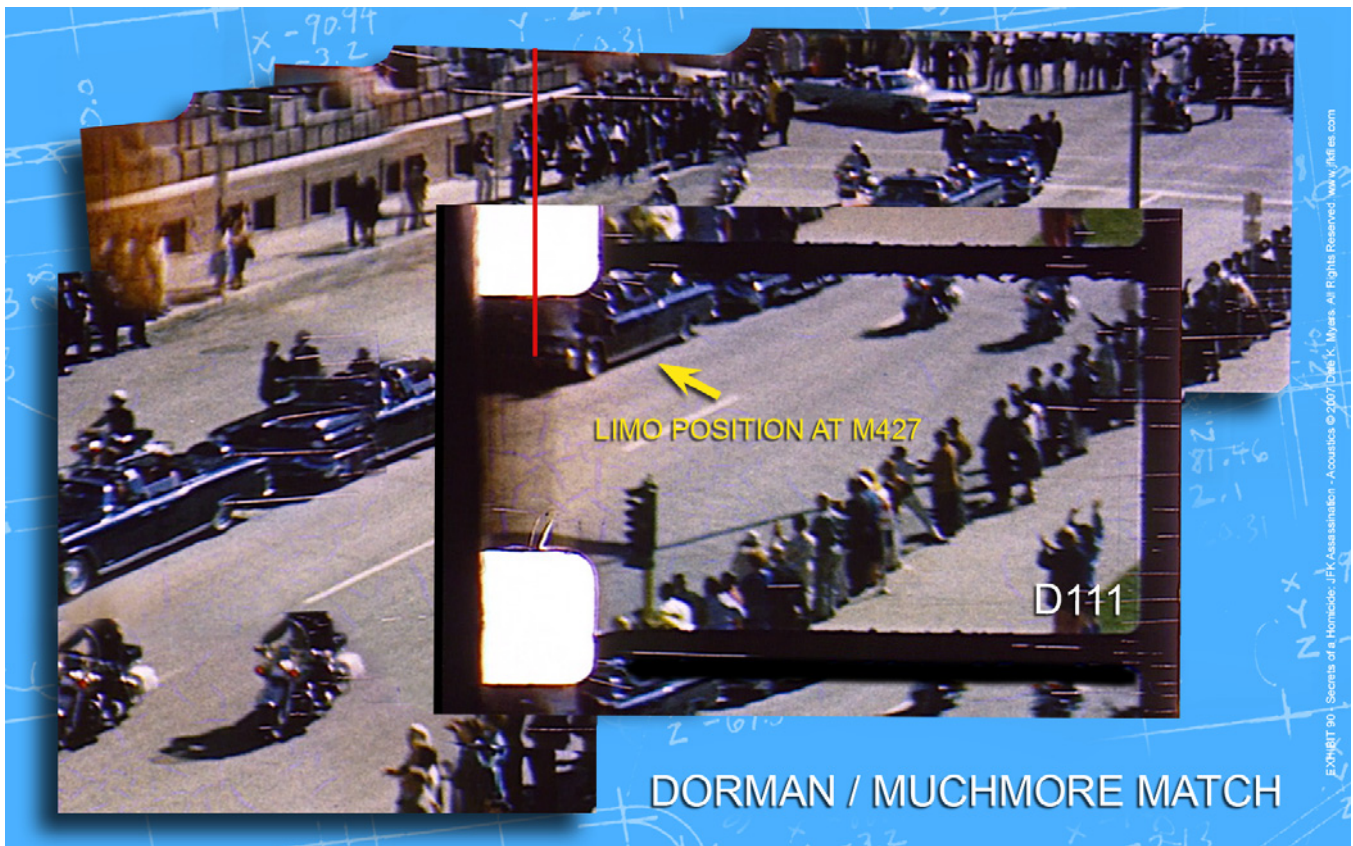


Exhibit 90. Composite mosaic image shows Dorman frame D111 is the equivalent of Muchmore M427.

M525-M526 (424 frame camera stop)

The camera was stopped for a period of 424 frames between Muchmore frames M525-M526. Frame M526 was slightly overexposed, indicating the camera restart. The total length of the stoppage was determined by synchronizing the restart frame to the Zapruder film and calculating the offset period. Muchmore frame M567 graphically depicts the fatal head shot and therefore is the equivalent of Zapruder frame Z313. The offset period between Muchmore frame M526 and M567 is 2.22 seconds ($567 - 526 = 41 \div 18.5 \text{ fps} = 2.22$), which demonstrates that Muchmore frame M526 was exposed at the equivalent of Zapruder frame Z272, or 2.22 seconds before the head shot.

Since Muchmore frame M525 was exposed 25.16 seconds before the head shot and Muchmore frame M526 was exposed 2.22 seconds before the head shot, then 22.94 seconds elapsed between the two exposures. Hence, the camera was stopped for 22.89 seconds ($22.94 - 0.054 [1 \text{ frame}] = 22.89$) which equates to 424 frames ($22.89 \times 18.5 = 424$).

(SEC-3) Elsie Dorman Film – Camera Frame Rate: 16.8 fps

The Elsie Dorman film consists of 5 sequences; 3 pre-assassination, 1 during the shooting, and 1 post assassination. Sequence 1 is the first that depicts the presidential limousine, which appears turning from Main onto Houston Street. Sequences 2 and 3 depict the limousine heading north on Houston and making the turn onto Elm Street. Sequence 4 depicts spectators standing on the south side of Elm Street as well as a glimpse of the Vice Presidential car and its Secret Service follow-up car. Sequence 5 depicts a glimpse of Mayor Cabell's car, spectators at the corner of southwest corner of Elm and Houston Streets, and two congressional cars and a motorcycle officer approaching the Houston and Elm Street intersection. These five sequences encompass frames D001 through D496 and are spread across a time period of 38.81 seconds; beginning 33.56 seconds before the fatal head shot and ending 5.25 seconds after the head shot. The frame rate of the Dorman camera, relative to Zapruder's camera, was determined to be 16.8 frames-per-second. There are 4 camera stops between Dorman frames D001-D496:

D045-D046 (32 frame camera stop)

The camera was stopped for a period of 32 frames between Dorman frames D045-D046. Frame D046 was slightly overexposed, indicating the camera restart. The total length of the stoppage was determined by synchronizing the restart frame to the Hughes film and calculating the offset period. Dorman sequence D001-D046 depicts the presidential limousine turning from Main onto Houston Street. Hughes sequence H370-H455 and Muchmore sequence M292-M378 also depict the limousine during this same period. An examination of all three films demonstrates:

(a) Dorman frame D045 was found to have been exposed 30.96 seconds before the head shot.

By comparing the relationship of the presidential limousine to the southern-most crosswalk on Houston at Main, and the pattern of the red emergency flashers on the limousine as depicted in the Dorman and Muchmore films, it was determined that Dorman frame D017 was the equivalent of Hughes frame H388 and Muchmore frame M310. ^[Exhibit 91] These three frames synchronize to a moment 32.63 seconds before the head shot. The offset period between Dorman frame D017 and D045 is 1.67 seconds ($45-17 = 28 \div 16.8 \text{ fps} = 1.67$), which demonstrates that Dorman frame D045 was exposed 30.96 seconds before the head shot.

(b) Dorman frame D046 was found to have been exposed 28.97 seconds before the head shot.

By comparing the relationship of the Presidential Secret Service Follow-Up Car to the northern-most crosswalk on Houston at Main, and motorcycle escort B.J. "Billy" Martin (riding on the inner left side of the limousine) to the left lane road stripe, it was determined that

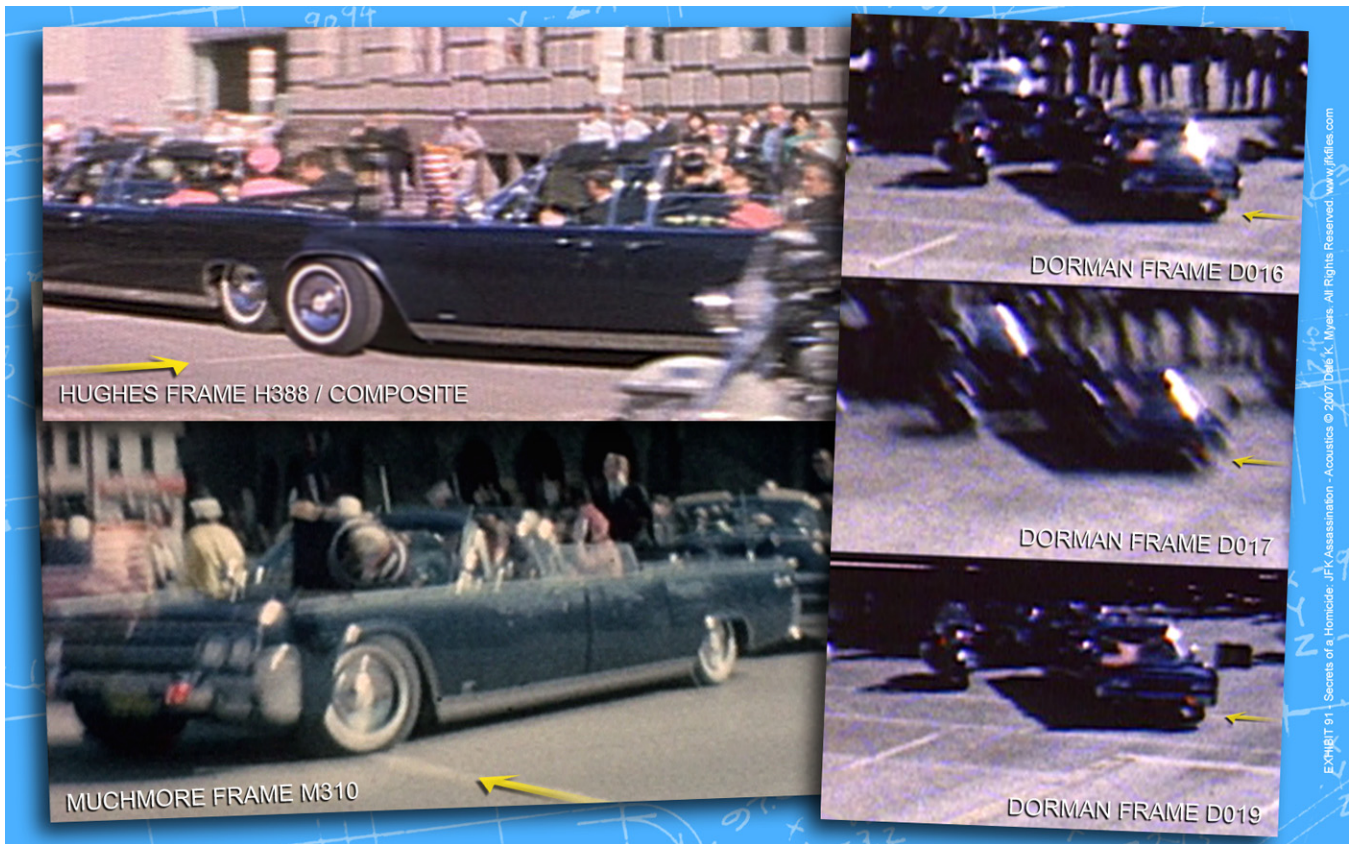


Exhibit 91. Crosswalk shows Dorman frame D017 synchronizes to Hughes H388 and Muchmore M310.

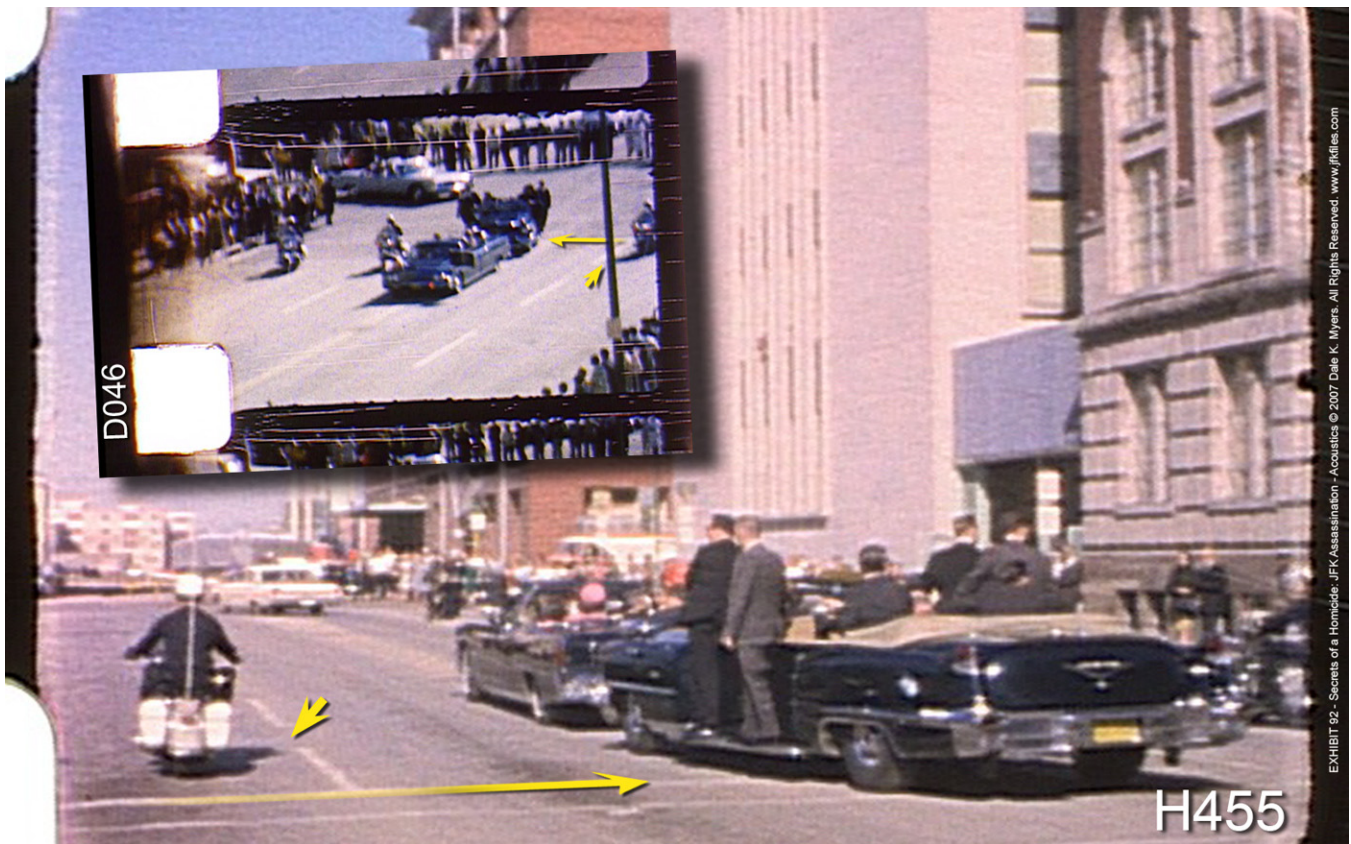


Exhibit 92. Crosswalk and road stripes show Dorman frame D046 synchronizes to Hughes frame H455.

Dorman frame D046 was the equivalent of Hughes frame H455, which was exposed 28.97 seconds before the head shot. ^[Exhibit 92]

Since Dorman frame D045 was exposed 30.96 seconds before the head shot and Hughes frame H455 was exposed 28.97 seconds before the head shot, then 1.99 seconds elapsed between the two exposures. Hence, the camera was stopped for 1.93 seconds ($1.99 - 0.060$ [1 frame] = 1.93) which equates to 32 frames ($1.93 \times 16.8 = 32$).

D191-D192 (30 frame camera stop)

The camera was stopped for a period of 30 frames between Dorman frames D191-D192. Frame D192 was slightly overexposed, indicating the camera restart. The total length of the stoppage was determined by examining the trajectory and speed of the Presidential Secret Service Follow-Up Car, the fifth car in the motorcade, between Dorman frames D191 and D196; then using the position and speed of the vehicle to calculate the elapsed time between those two points. Subtracting the elapsed time between D192 and D196 revealed the total length of time the camera was stopped between Dorman frames D191 and D192. The following steps were taken:

(a) The Presidential Secret Service Follow-Up Car's speed immediately prior to Dorman frame D191 was calculated to be 14.13 feet/second (9.6 mph).

Since the Dorman film shows the Presidential Secret Service Follow-Up Car to be moving at the same speed as the presidential limousine, the limousine was used to calculate the speed of the Secret Service vehicle. The presidential limousine was found to traverse its own wheelbase (13 feet) between Dorman frames D157.5 and D173 – a total of 15.5 frames. Dividing the speed of the Dorman camera (16.8 frames/second) into the frame count yields a time of 0.92 seconds. This calculates to a speed of 14.13 feet/second (9.6 mph). ^[Exhibit 93]

(b) The Presidential Secret Service Follow-Up Car's speed immediately after Dorman frame D196 was calculated to be 9.90 feet/second (6.8 mph).

Again, because the Presidential Secret Service Follow-Up Car was found to be moving at the same speed as the presidential limousine, the limousine was used to calculate the speed of the Secret Service vehicle. Towner frames T006 through T032, which depict the presidential limousine beginning its turn onto Elm Street, shows the limousine moving at a speed of 9.90 feet/second (6.8 mph). [See *Appendix I*, Exhibit 27, p.56]

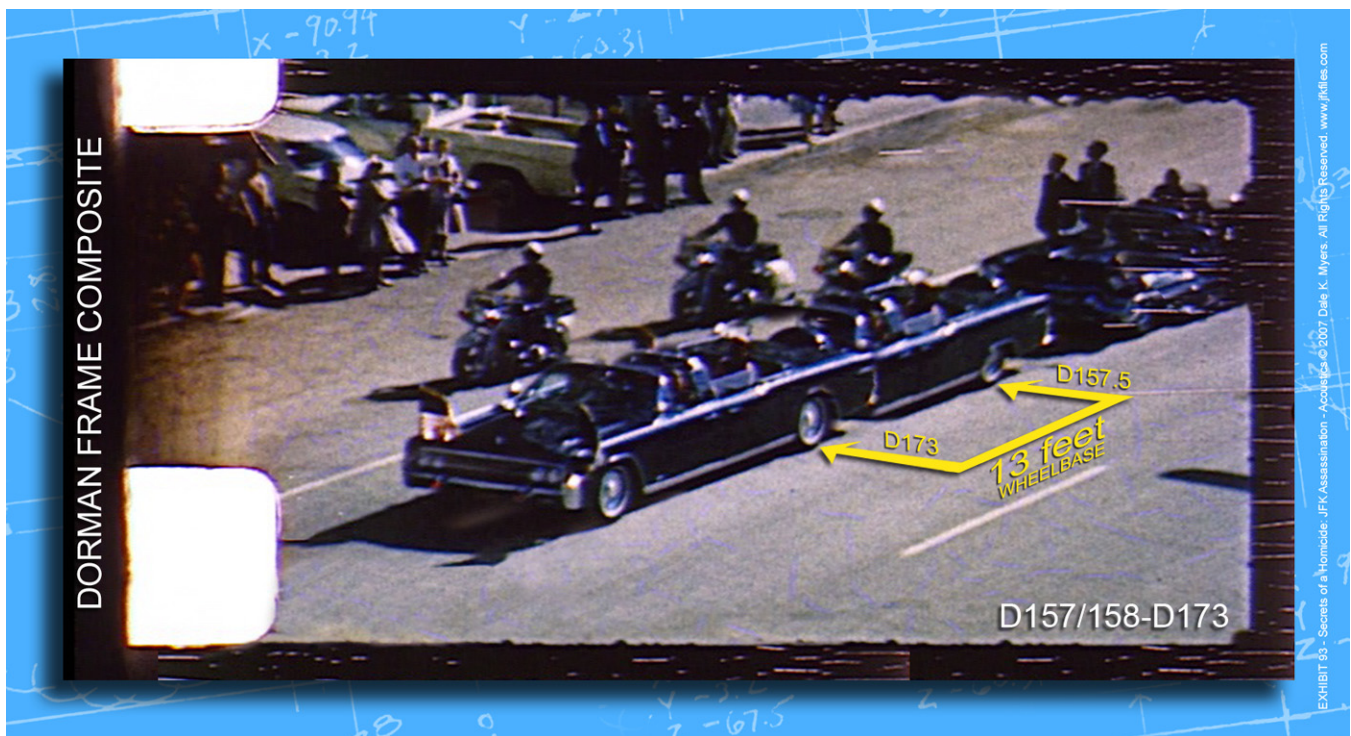


Exhibit 93. Plotting the distance traversed by the presidential limousine between Dorman D157/158-D173.

(c) The Presidential Secret Service Follow-Up Car's average speed between Dorman frames D191 and D196 was estimated to be 12.02 feet/second (8.2 mph).

Adding the estimated speed of the Presidential Secret Service Follow-Up Car prior to Dorman frame D191 (14.13 feet/second) to the estimated speed of the Secret Service vehicle after Dorman frame D196 (9.90 feet/second) and dividing the result by two calculates to an estimated average speed of 12.02 feet/second (8.2 mph) between Dorman frames D191 and D196.

(d) A computer model of the position of the Presidential Secret Service Follow-Up Car at Dorman frames D191 and D196 shows that it traverses a distance of 26.13 feet.

A composite mosaic image was created from multiple Dorman frames to aid in determining the location of the Presidential Secret Service Follow-Up Car at Dorman frames D191 and D196. A computer model of the Secret Service car was positioned to match Dorman frame D191 by noting the vehicle's relationship to a line-of-sight drawn between Dorman's camera and the base windows on the west wall of the Dallas County Courthouse Building. A computer model of the Secret Service car was also positioned to match Dorman frame D196 by noting the vehicle's relationship to a similar line-of-sight. ^[Exhibit 94] The distance between these two positions (rear bumper-to-rear bumper) was measured at 26.13 feet.

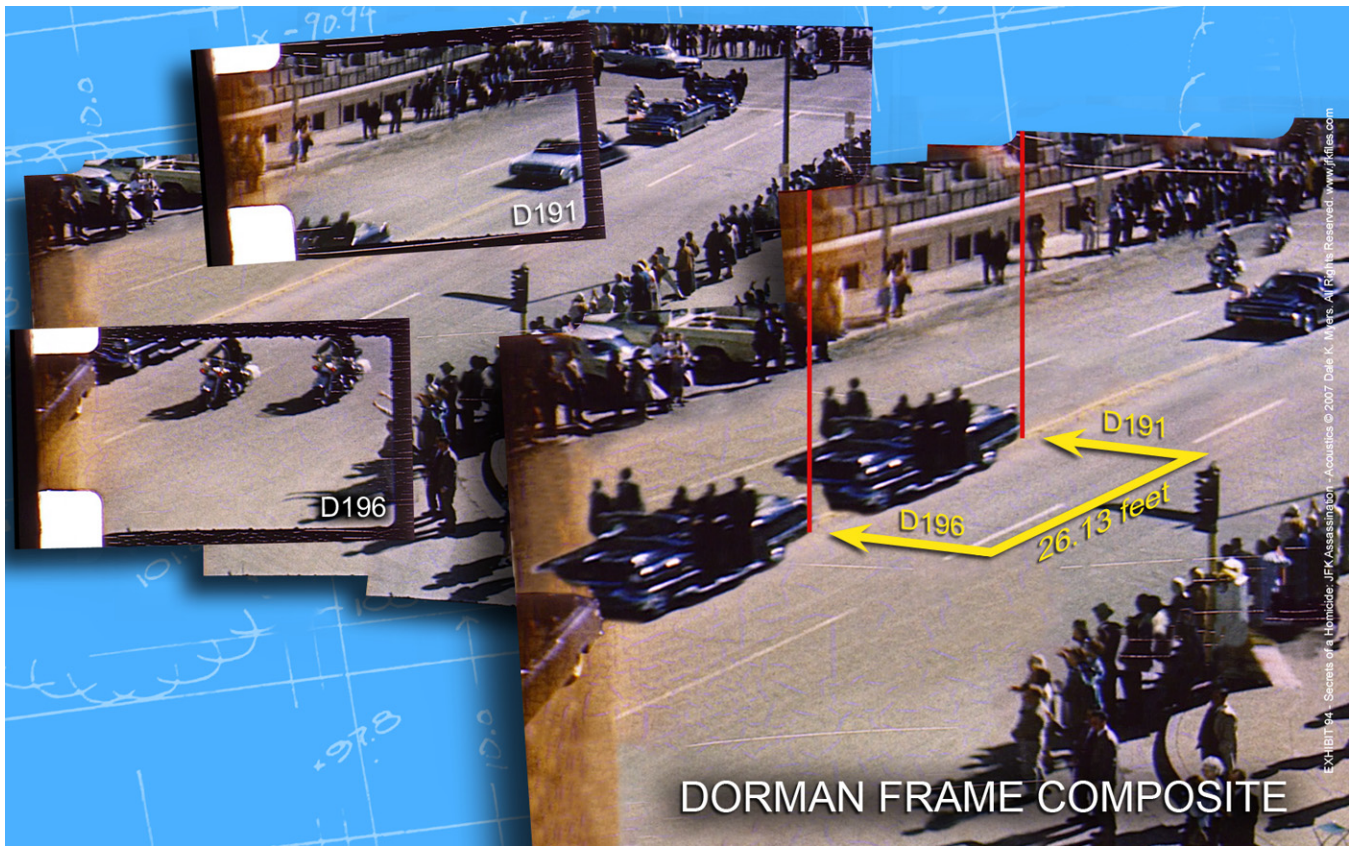


Exhibit 94. Composite mosaic image used to position the PSS car at Dorman frames D191 and D196.

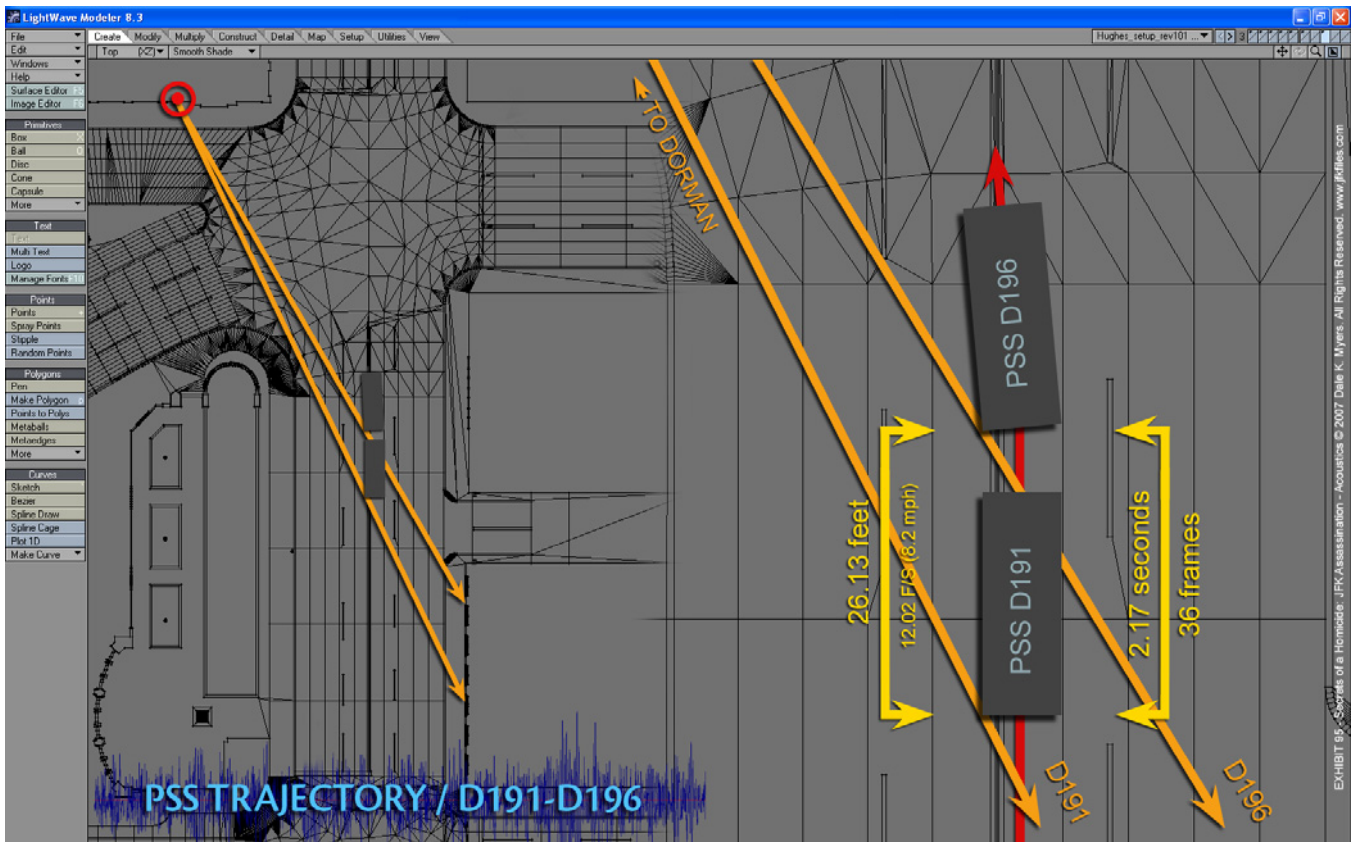


Exhibit 95. Plotting the distance traversed by the PSS car between Dorman frames D191 and D196.

(e) The Presidential Secret Service Follow-Up Car would have traversed the 26.13 feet between Dorman frames D191 and D196 in 2.17 seconds traveling at an estimated speed of 12.02 feet/second (8.2 mph).

The estimated speed of the Presidential Secret Service Follow-Up Car during this period was an average speed based on the speed of the presidential limousine as described above. The trajectory and speed of the Secret Service car demonstrates that 2.17 seconds elapsed between the exposure of Dorman frames D191 and D196. ^[Exhibit 95] Subtracting the 0.30 second difference between Dorman frames D196 and D191 (5 frames ÷ 16.8 fps = 0.30) yields a total elapsed time of 1.87 seconds. Multiplying the elapsed time by the frame rate of the Dorman camera yields an actual frame count of 31 frames (1.87 x 16.8 = 31) between Dorman frame D191 and D192. Therefore, the Dorman camera was stopped for 30 frames between the two exposures.

In conclusion, the five calculations above demonstrate that a 30 frame camera stop between Dorman frames D191-D192 maintains the trajectory and speed of the Presidential Secret Service Follow-Up Car on Houston Street and is consistent with the known relative speed of the motorcade procession.

D335-D336 (49 frame camera stop)

The camera was stopped for a period of 49 frames between Dorman frames D335-D336. Frame D336 was slightly overexposed, indicating the camera restart. The total length of the stoppage was determined by synchronizing the restart frame to the Zapruder film and calculating the offset period. Dorman sequence D336-D375 contains images of Hugh Betzner Jr., (D345-D355) lowering his camera after taking a photograph known to have been exposed at the equivalent of Zapruder frame Z186. [See *Appendix II, Synchronizing the Dorman and Zapruder Films*, p.95] Dorman frames D345-D355 synchronize to Zapruder frames Z195-Z206, which also shows Betzner lowering his camera in the sprocket area of the image. Since Dorman frame D345 is the equivalent of Zapruder frame Z195, Dorman frame D345 was exposed 6.45 seconds (313-195 = 118 ÷ 18.3 = 6.45) before the head shot. Since the difference between Dorman frame D336 (the beginning of the sequence) and Dorman frame D345 is 9 frames (0.536 seconds), Dorman frame D336 would be the equivalent of Zapruder frame Z185 (0.536 x 18.3 = 10 / Z195 - 10 = 185). Therefore, Dorman frame D336 was exposed 7.00 seconds (313-185 = 128 ÷ 18.3 = 7.00) before the head shot. Since Dorman frame D335 was exposed 9.97 seconds before the head shot and Dorman frame D336 was exposed 7.00 seconds before the head shot, then 2.97 seconds elapsed between the two exposures. Hence, the camera was stopped for 2.91 seconds (2.97 - 0.060 [1 frame] = 2.91) which equates to 49 frames (2.91 x 16.8 = 49).

D375-D376 (45 frame camera stop)

The camera was stopped for a period of 45 frames between Dorman frames D375-D376. Frame D376 was slightly overexposed, indicating the camera restart. The total length of the stoppage was determined by synchronizing the restart frame to the Zapruder film using the Dave Wiegman film and calculating the offset period. A detailed geometric analysis of the

three films [See *Appendix II*, The Wiegman Film, Exhibits 72-76, pp.100-102] found that Dorman frame D376 is the equivalent of Zapruder frame Z278. Therefore, Dorman frame D376 was exposed 1.91 seconds ($313-278 = 35 \div 18.3 = 1.91$) before the head shot. A detailed analysis of Dorman sequence D336-D375 also found that D375 is the equivalent of Zapruder frame Z228 [See above] and therefore, Dorman frame D375 was exposed 4.65 seconds before the fatal head shot. Since Dorman frame D375 was exposed 4.65 seconds before the head shot and Dorman frame D376 was exposed 1.91 seconds before the head shot, then 2.74 seconds elapsed between the two exposures. Hence, the camera was stopped for 2.68 seconds ($2.74 - 0.060$ [1 frame] = 2.68) which equates to 45 frames ($2.68 \times 16.8 = 45$).

(SEC-4) Orville Nix Film – Camera Frame Rate: 18.5 fps

The Orville Nix film consists of 3 sequences; 1 pre-assassination, 1 during the shooting, and 1 post assassination. Sequence 1 depicts the presidential limousine completing its turn from Main onto Houston Street and continuing northbound trailed by the Secret Service Follow-Up Car and the Vice Presidential Car. Sequence 2 depicts the presidential limousine on Elm street during the shooting and is the equivalent of Zapruder frames Z291 through Z411. Sequence 3 depicts the north side of Elm Street shortly after the shooting. The first two sequences encompass frames N001 through N296 and are spread across a time period of 38.59 seconds; beginning 33.26 seconds before the fatal head shot and ending 5.33 seconds after the head shot. The frame rate of the Nix camera was determined by the FBI to be 18.5 frames-per-second. There is 1 camera stop between Nix frames N001-N296:

N174-N175 (419 frame camera stop)

The camera was stopped for a period of 419 frames between Nix frames N174-N175. Frame N175 was slightly overexposed, indicating the camera restart. An examination of four films demonstrates:

(a) Nix frame N174 was found to have been exposed 23.91 seconds before the head shot.

Governor Connally can be seen lifting his hand in a wave in the Nix, Muchmore, and Hughes films as the limousine traverses the crosswalk on Houston at Main. By comparing the position of Connally's hand as depicted in these three films, it was determined that Nix frame N040 was the equivalent of Hughes frame H415 and Muchmore frame M338. [See Exhibit 88, p.127] These three frames synchronize to a moment 31.15 seconds before the head shot. The offset period between Nix frame N040 and N174 is 7.24 seconds ($174 - 40 = 134 \div 18.5 \text{ fps} = 7.24$), which demonstrates that Nix frame N174 was exposed 23.91 seconds ($31.15 - 7.24 = 23.91$) before the head shot.

(b) Nix frame N175 was found to have been exposed 1.20 seconds before the head shot.

Nix frame N197 graphically depicts the fatal head shot and therefore is the equivalent of Zapruder frame Z313. The offset period between Nix frame N175 and N197 is 1.20 seconds ($197 - 175 = 22 \div 18.5 \text{ fps} = 1.20$), which demonstrates that Nix frame N175 was exposed at the equivalent of Zapruder frame Z291, or 1.20 seconds before the head shot.

Since Nix frame N174 was exposed 23.91 seconds before the head shot and Nix frame N175 was exposed 1.20 seconds before the head shot, then 22.71 seconds elapsed between the two exposures. Hence, the camera was stopped for 22.66 seconds ($22.71 - 0.054 [1 \text{ frame}] = 22.66$) which equates to 419 frames ($22.66 \times 18.5 = 419$).

(SEC-5) Tina Towner Film – Camera Frame Rate: 22.8 fps

The Tina Towner film consists of 2 sequences; 1 pre-assassination, and 1 post assassination. Sequence 1 depicts the presidential limousine turning from Houston onto Elm Street and continuing a short distance down Elm. Sequence 2 depicts the north side of Elm Street a few minutes after the shooting. The first sequence encompasses frames T001 through T160 and covers a time period of 7.27 seconds; beginning 17.93 seconds before the fatal head shot and ending 10.66 seconds before the head shot. The frame rate of the Towner camera, relative to Zapruder's camera, was determined to be 22.8 frames-per-second. There are no camera stops and 1 splice between Towner frames T084-T085:

T084-T085 Splice (7 frames missing)

Seven frames were found to be missing at the point of a film splice between Towner frames T084-T085. This was determined by using a composite image to examine the progression of the presidential limousine as it traverses the Elm and Houston intersection. The result shows 7 frames to be missing at the point of the splice. [See *Appendix I, Exhibit 24, p.54*]

(SEC-6) F.M. "Mark" Bell Film – Camera Frame Rate: 19.0 fps

The F.M. "Mark" Bell film consists of 14 sequences; 3 pre-assassination and 11 post assassination. The third sequence depicts the presidential limousine passing in front of the Texas School Book Depository after turning from Houston onto Elm Street, and was the only sequence used in this study. The third sequence encompasses frames numbered B001 through B060 and covers a time period of 3.16 seconds; beginning 14.69 seconds before the fatal head shot and ending 11.58 seconds before the head shot. The frame rate of the Bell camera,

relative to Zapruder's camera, was determined to be 19.0 frames-per-second. There are no camera stops or splices during the third sequence identified as Bell frames B001 through B060.

(SEC-7) John Martin, Jr., Film – Camera Frame Rate: 22.8 fps

The John Martin, Jr., film consists of 9 sequences; 6 pre-assassination and 3 post assassination. Sequence 1 depicts the lead motorcycles turning from Main Street onto Houston Street. Sequences 2 and 3 depict the lead vehicle driven by Dallas Police Chief Jesse Curry turning from Main onto Houston Street. Sequences 4 and 5 depict the presidential limousine as it turns off of Main Street and travels north on Houston Street. Sequence 6 depicts the presidential limousine passing in front of the Texas School Book Depository, and eyewitness Rosemary Willis running alongside the south side of Elm Street. Sequences 7, 8, and 9 depict events in Dealey Plaza following the assassination. The sixth sequence encompasses frames MN207 through MN278 and covers a time period of 3.15 seconds; beginning 12.54 seconds before the fatal head shot and ending 9.45 seconds before the head shot. The frame rate of the Martin camera, relative to Zapruder's camera, was determined to be 22.8 frames-per-second. There are no camera stops or splices between Martin frames MN207-MN278.

(SEC-8) Abraham Zapruder Film – Camera Frame Rate: 18.3 fps

The Abraham Zapruder film consists of 3 sequences; 2 pre-assassination and 1 during the shooting. Sequence 1 depicts Marilyn Sitzman standing near Charles and Beatrice Hester, who are seated on a park bench. Sequence 2 depicts the three lead motorcycles turning from Houston onto Elm Street, one-half block ahead of the motorcade lead car. Sequence 3 depicts the presidential limousine just after it had completed its turn onto Elm Street. The third sequence encompasses frames Z133 through Z486 and covers a time period of 19.29 seconds; beginning 9.84 seconds before the fatal head shot and ending 9.45 seconds after the head shot. The frame rate of the Zapruder camera was determined by the FBI to be 18.3 frames-per-second. There are no camera stops and 2 splices between Zapruder frames Z133-Z486:

Z154-Z157 Splice (2 frames missing)

Two frames are missing at the point of a film splice between Zapruder frames Z154-Z157. Three first-generation copies made before the original film was damaged shows that 2 frames are missing at the point of the splice.¹⁴⁷

147. Trask, Richard B., *Pictures of the Pain*, Yeoman Press, 1994, p.97

Z207-Z212 Splice (4 frames missing)

Four frames are missing at the point of a film splice between Zapruder frames Z207-Z212. Three first-generation copies made before the original film was damaged shows that 4 frames are missing at the point of the splice.¹⁴⁸

(SEC-9) Dave Wiegman Film – Camera Frame Rate: 24 fps

The Dave Wiegman film consists of 22 sequences; 10 pre-assassination, 1 during the shooting, and 11 post-assassination. Sequence 11 depicts the motorcade in Dealey Plaza during the shooting and is the focus of this study. The sequence begins when Camera Car 1, in which Wiegman is riding, is in front of the Texas School Book Depository. With the camera running, Wiegman leaps from the car and dashes up toward the pergola on the north side of Elm Street, where he films Mr. and Mrs. Charles Hester falling to the ground. The portion of the Sequence 11 used in this study encompasses frames numbered W001 through W316 and covers a time period of 13.17 seconds; beginning 3.66 seconds before the fatal head shot and ending 9.45 seconds after the head shot. The frame rate of the Wiegman news camera was 24 frames-per-second. There are no camera stops or splices during the portion of the eleventh sequence identified as Wiegman frames W001 through W316.

(SEC-10) Charles L. Bronson Film – Camera Frame Rate: 12 fps

The Charles Bronson film consists of 13 sequences; 3 pre-assassination, 1 during the shooting, and 9 post-assassination. Sequence 1 depicts ambulance attendants administering to an epileptic on Houston Street about 6 minutes before the shooting. The sixth floor window of the Texas School Book Depository is visible during this sequence. Sequence 2 depicts several motorcycle escorts turning from Main on Houston Street. Sequence 3 depicts the presidential limousine traveling north on Houston Street. Sequence 4 depicts the presidential limousine on Elm Street during the shooting and is the focus of this study. Sequences 5 through 13 depict various views of crowds in Dealey Plaza on Saturday, November 23, 1963. Sequence 4 encompasses frames numbered BN243 through BN268 and covers a time period of 2.09 seconds; beginning 0.92 seconds before the fatal head shot and ending 1.17 seconds after the head shot. The frame rate of the Bronson camera was 12 frames-per-second. There are no camera stops or splices between Bronson frames BN243-BN268.

While the Bronson film is one of only four known films that depict portions of the shooting sequence, Bronson was standing approximately 221 feet from the limousine's position on Elm Street and consequently was unable to capture images of any great detail.

148. Trask, Richard B., *Pictures of the Pain*, Yeoman Press, 1994, pp.96-97

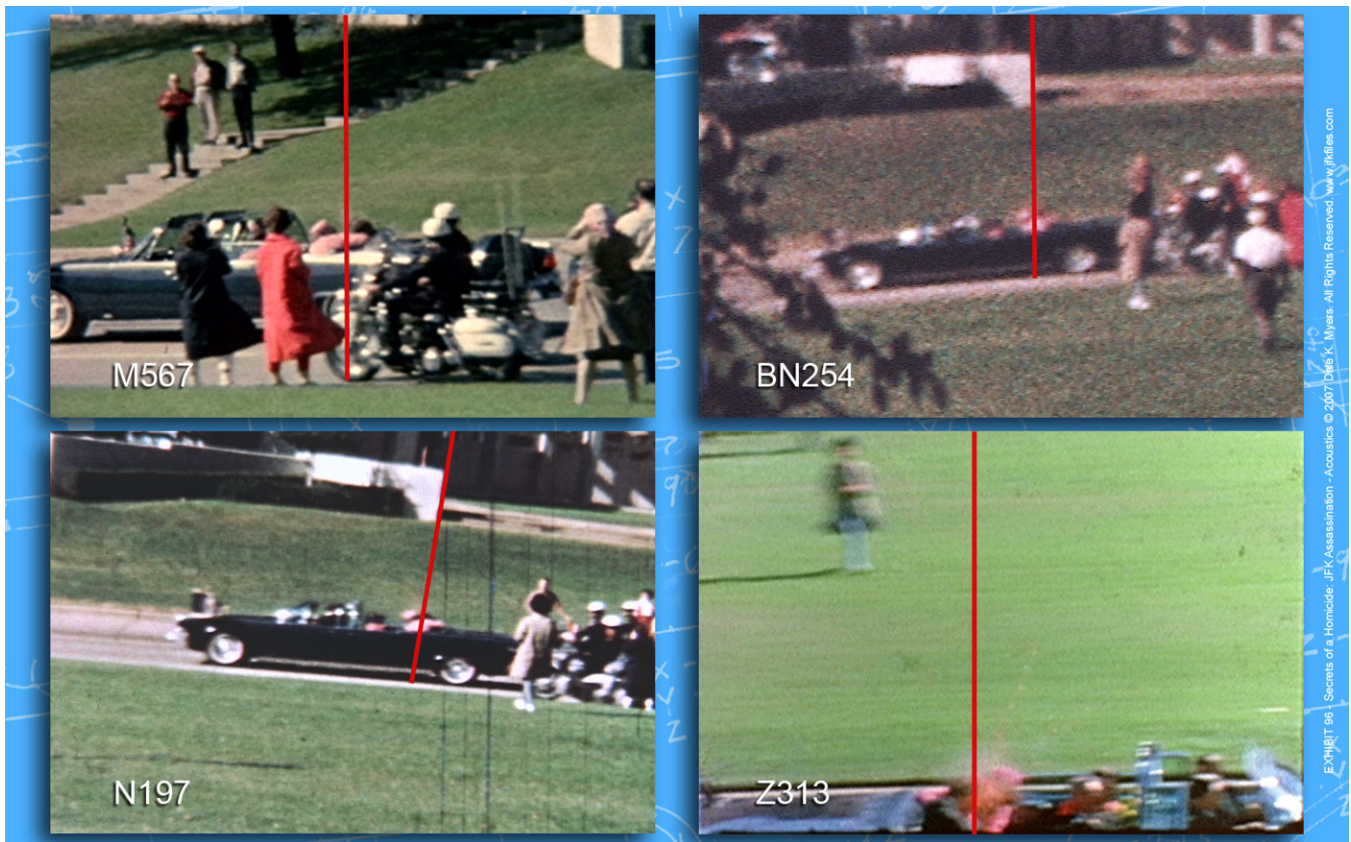


Exhibit 96. Plotting the position of the presidential limousine based on the views of four amateur cameramen.

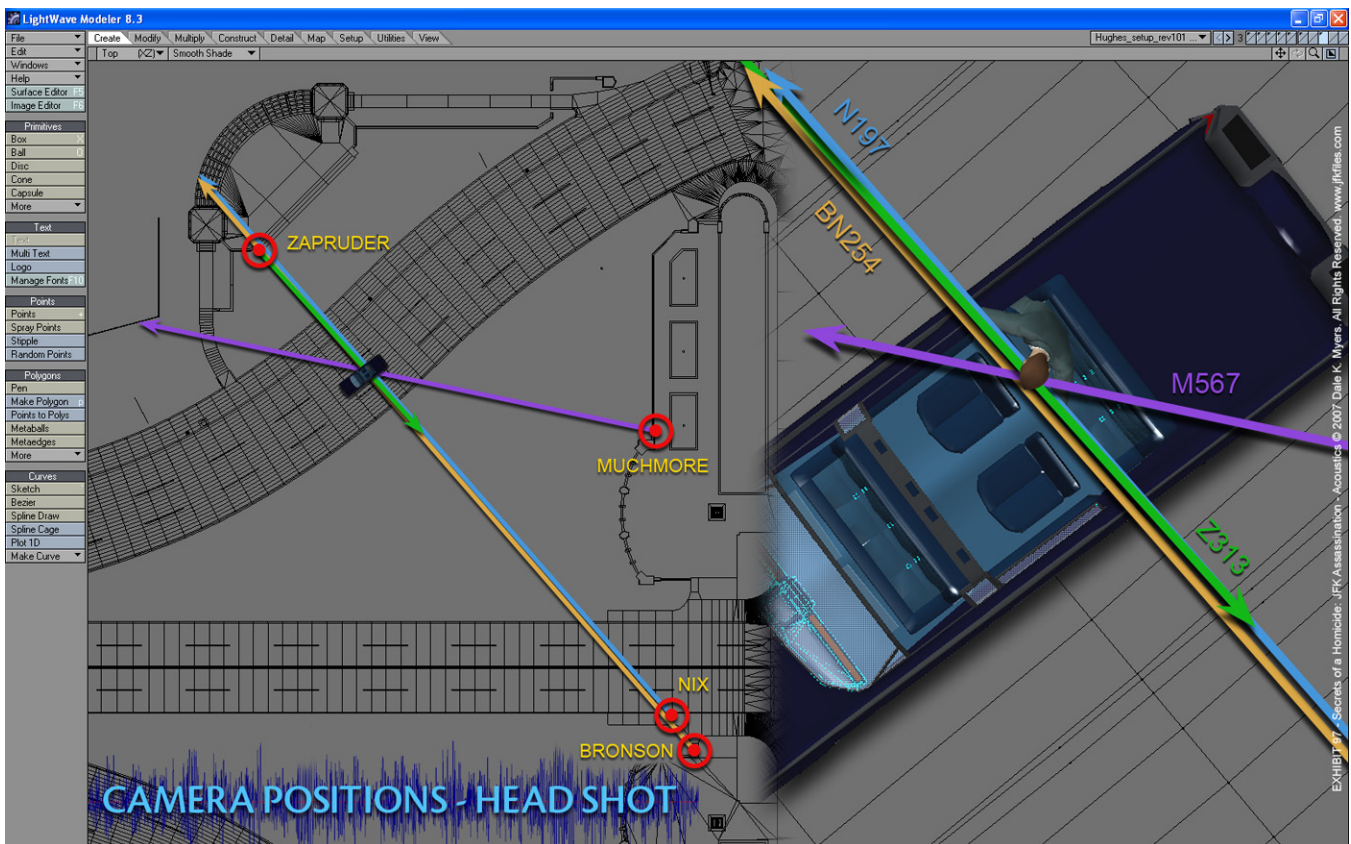


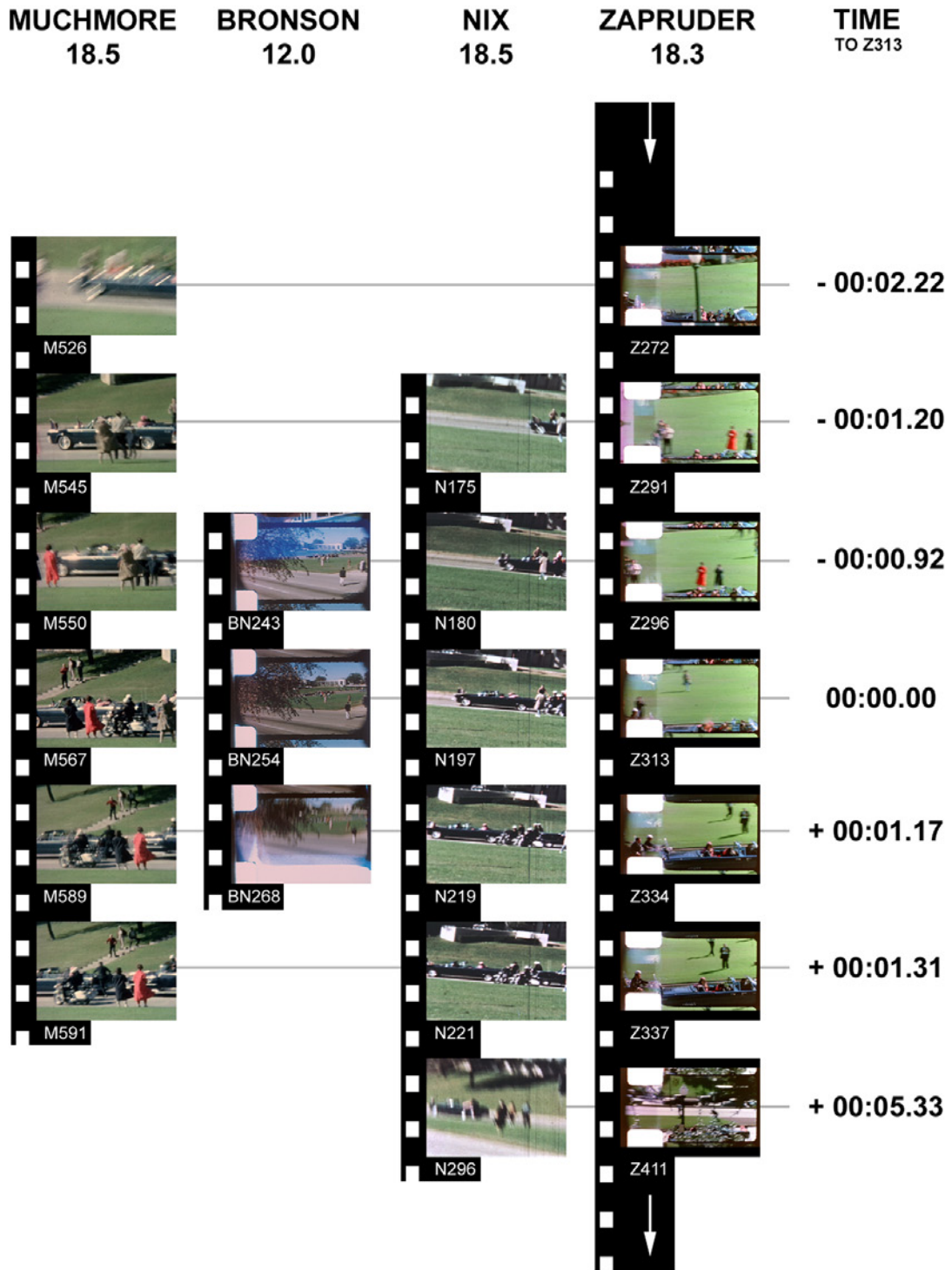
Exhibit 97. Plotting the position of the limousine and four photographers at the time of the fatal head shot.

The four films that capture portions of the shooting sequence are Zapruder, Nix, Muchmore and Bronson. All four films depict the fatal head shot. The four individual frames which depict the fatal head shot - Muchmore (M567), Bronson (BN254), Nix (N197) and Zapruder (Z313) ^[Exhibit 96] - contain enough information to triangulate the position of the limousine as well as determine the location of each photographer. This was accomplished by projecting lines-of-sight between the photographers and fixed objects seen in the background of each individual frame. ^[Exhibit 97]

A synchronized timeline chart covering the 7.55 seconds surrounding the fatal head shot was assembled to show the relationship between the four only known amateur films that captured the event. ^[Amateur Film Synchronization Timeline - Fatal Head Shot Sequence]

AMATEUR FILM SYNCHRONIZATION TIMELINE

EPIPOLAR GEOMETRIC ANALYSIS OF AMATEUR FILMS RELATED TO ACOUSTICS EVIDENCE IN THE JOHN F. KENNEDY ASSASSINATION
FATAL HEAD SHOT SEQUENCE



APPENDIX IV

NINE VISUAL REFERENCE POINTS COMMON TO THE HUGHES, TOWNER, DORMAN, BELL, AND MARTIN FILMS CONFIRM THE VALIDITY OF SYNCHRONIZING HUGHES FRAME H648 TO ZAPRUDER FRAME Z150

An examination of five of the amateur films used in this study resulted in the location of nine visual reference points common to the Hughes, Towner, Dorman, Bell, and Martin films.

When the nine visual reference points are aligned, they produce a continuous and overlapping motion picture record of the presidential limousine's progression through the turn at Elm and Houston.

This multi-camera motion picture record provides a visual link between the Hughes and Zapruder films and offers additional corroboration for the validity of the synchronization of Hughes frame H648 to Zapruder frame Z150 (+/- one frame).

It also validates and confirms the camera running speeds of the Hughes, Towner, Dorman, Bell, and Martin cameras (relative to the Zapruder camera) as deduced in this analysis.

Preparation and Results

Each of the above named films was stabilized and enlarged using digital techniques previously discussed. (see *Stabilization Techniques*, p.35) An examination was conducted to determine if the films contained any common visual elements. Particular attention was paid to crowd movements in the background of each film.

Nine visual reference points (VRP) common to two or more films were subsequently discovered and are described as follows [*Note: QuickTime video versions of all nine exhibits in this appendix are available online here.*]:

(VRP-1) A woman standing on the southwest corner of Elm and Houston provides a synchronization point between Hughes and Dorman – H535/D210 to H543/D217.

In the Dorman film, a woman wearing a dark coat and a red and white patterned babushka [see *Exhibit 98*, No.1] can be seen standing in the crowd on the southwest corner of Elm and Houston and waving at the passing presidential limousine. Between frames D210 and D217, she drops her arm and steps or leans forward into the street.

This same action can be seen in the Hughes film between frames H535 and H543.



Exhibit 98. Synchronization between Hughes and Dorman – H535/D210 to H543/D217.



Exhibit 99. Synchronization between Hughes and Towner – H559/T043 to H582/T071.

(VRP-2) A Dallas police officer stationed at the intersection of Elm and Houston provides a synchronization point between Hughes and Towner – H559/T043 to H582/T071.

In the Towner film, a Dallas police officer [see *Exhibit 99*, No.1] can be seen standing in the middle of the intersection of Elm and Houston as the presidential limousine passes. Between frames T043 and T071, he steps or leans toward frame right, then back to the left.

This same action can be seen in the Hughes film between frames H559 and H582.

(VRP-3) A boy and woman standing on the southwest corner of Elm and Houston provides a synchronization point between Dorman and Bell – D259/B005 to D280/B029.

In the Dorman film, a boy [see *Exhibit 100*, No.1] and a woman [No.2] can be seen standing on the southwest corner of Elm and Houston and waving at the passing presidential limousine. Between frames D259 and D263, the woman lowers her arm. Between frames D268 and D277, the boy lowers his arm.



Exhibit 100. Synchronization between Dorman and Bell – D259/B005 to D280/B029.

These same actions can be seen in the Bell film between frames B005 and B009, and B015 and B025 respectively.

(VRP-4) Three women standing just east of the southeast corner of the Texas School Book Depository provides a synchronization point between Hughes, Towner and Bell – H585/T075/B001 to H593/T084/B008.

In the Towner film, a woman wearing a white coat [see *Exhibit 101*, No.1], a woman with sunglasses in a white coat [No.2], and a woman in a dark coat [No.3] can be seen standing on Houston, just east of the southeast corner of the Texas School Book Depository, watching the passing presidential limousine.

Between frames T081 and T084 of the Towner film, the woman wearing a white coat [No.1] begins to lower her arm (before a film splice after T084 interrupts the motion). This same action can be seen in the Bell film between frames B006 and B014. Although the woman is visible in the corresponding frames of the Hughes film – H590 to H598 – the movement of her arm is not as readily apparent due to the distance between the Hughes camera and the subject.

Between frames T075 and T081 of the Towner film, the woman with sunglasses in a white coat [No.2] lowers her arm. This same action can be seen in the Hughes film between frames H585 and H590. The woman is not visible in the corresponding frames of the Bell film – B001 to B006 – due to another spectator standing between the Bell camera and the subject.

Between frames T075 and T084 of the Towner film, the woman in a dark coat [No.3] turns to her left as the limousine passes. This same action can be seen in the Hughes film between frames H585 and H593 and in the Bell film between frames B001 and B008.

(VRP-5) A man standing just east of the southeast corner of the Texas School Book Depository provides a synchronization point between Towner and Bell – T085/B015 to T090/B019.

In the Towner film, a heavysset man wearing a brown sport jacket and gray slacks [see *Exhibit 102*, No.1] can be seen standing on Houston, just east of the southeast corner of the Texas School Book Depository, watching the passing presidential limousine. Between frames T085 and T090, he pulls his right hand out of his pocket and lifts it to wave.

This same action can be seen in the Bell film between frames B015 and B019.



Exhibit 101. Synchronization between Hughes, Towner, and Bell – H585/T075/B001 to H593/T084/B008.



Exhibit 102. Synchronization between Towner and Bell – T085/B015 to T090/B019.

(VRP-6) A man standing just south of the southeast corner of the Texas School Book Depository provides a synchronization point between Towner and Bell – T094/B022 to T100/B028.

In the Towner film, a man wearing light-colored clothing and a cowboy hat [see *Exhibit 103*, No.1] can be seen standing just south of the southeast corner of the Texas School Book Depository waving at the passing presidential limousine. Between frames T094 and T100, he lowers his right arm.

This same action can be seen in the Bell film between frames B022 and B028.

(VRP-7) A woman standing on the north curb of Elm Street in front of the main entrance to the Texas School Book Depository provides a synchronization point between Towner and Bell – T110/B035 to T114/B039.

In the Towner film, a woman wearing a brown coat [see *Exhibit 104*, No.1] can be seen standing on the north curb of Elm Street, in front of the main entrance to the Texas School Book Depository, waving at the passing presidential limousine. Between frames T110 and T114, she lowers her right arm.

This same action can be seen in the Bell film between frames B035 and B039.

(VRP-8) A man and woman descending the stairs near the reflecting pool on the southwest corner of Elm and Houston provides a synchronization point between Dorman, Martin, and Bell – D304/MN224/B056 to D308/MN229/B060.

In the Dorman film, a man [see *Exhibit 105*, No.1] and woman [No.2] can be seen descending the stairs near the reflecting pool on the southwest corner of Elm and Houston between frames D304 and D319.

This same action can be seen in the Martin film between frames MN224 and MN245. A portion of this action can also be seen in the Bell film between frames B056 and B060, when Bell stops filming.



Exhibit 103. Synchronization between Towner and Bell – T095/B022 to T100/B028.

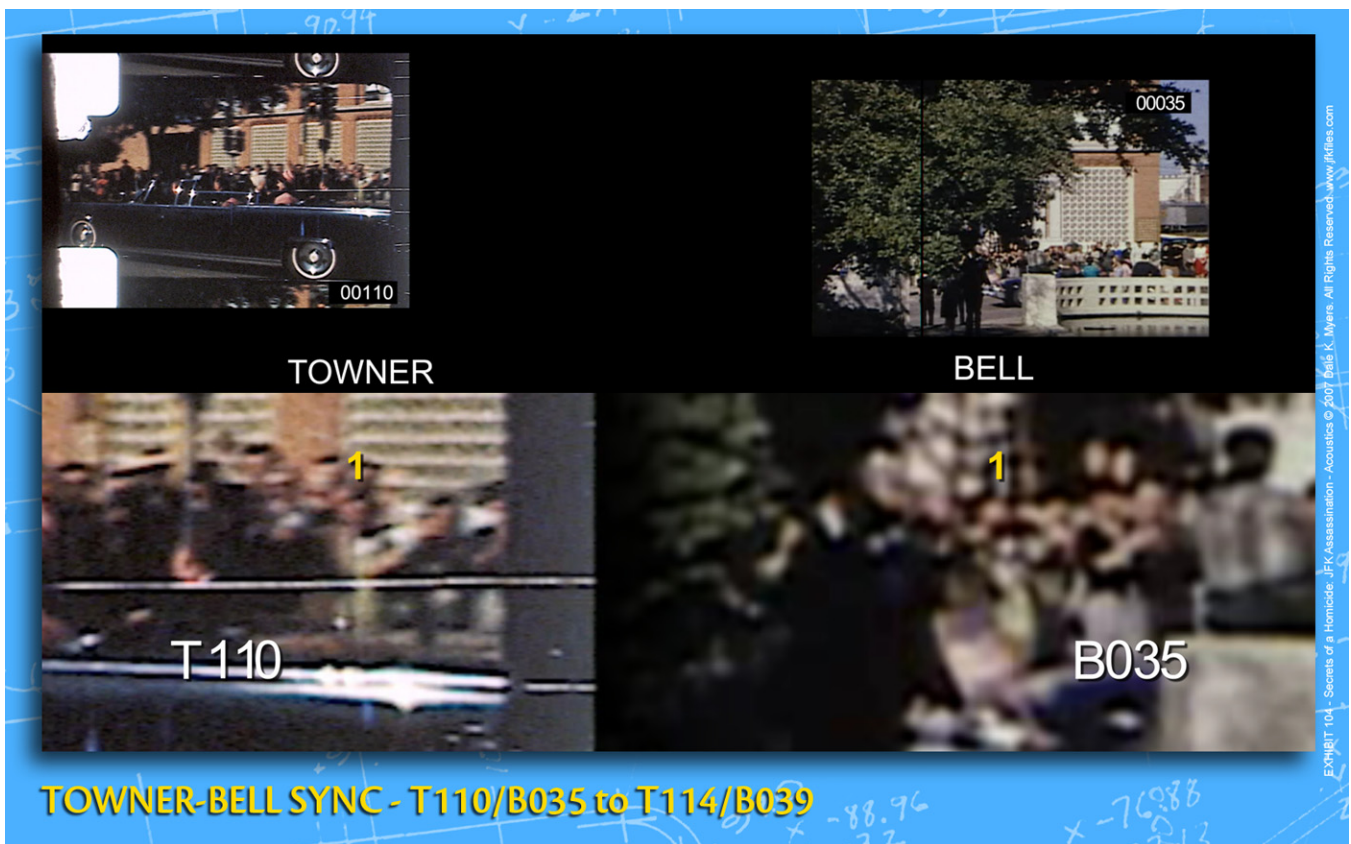
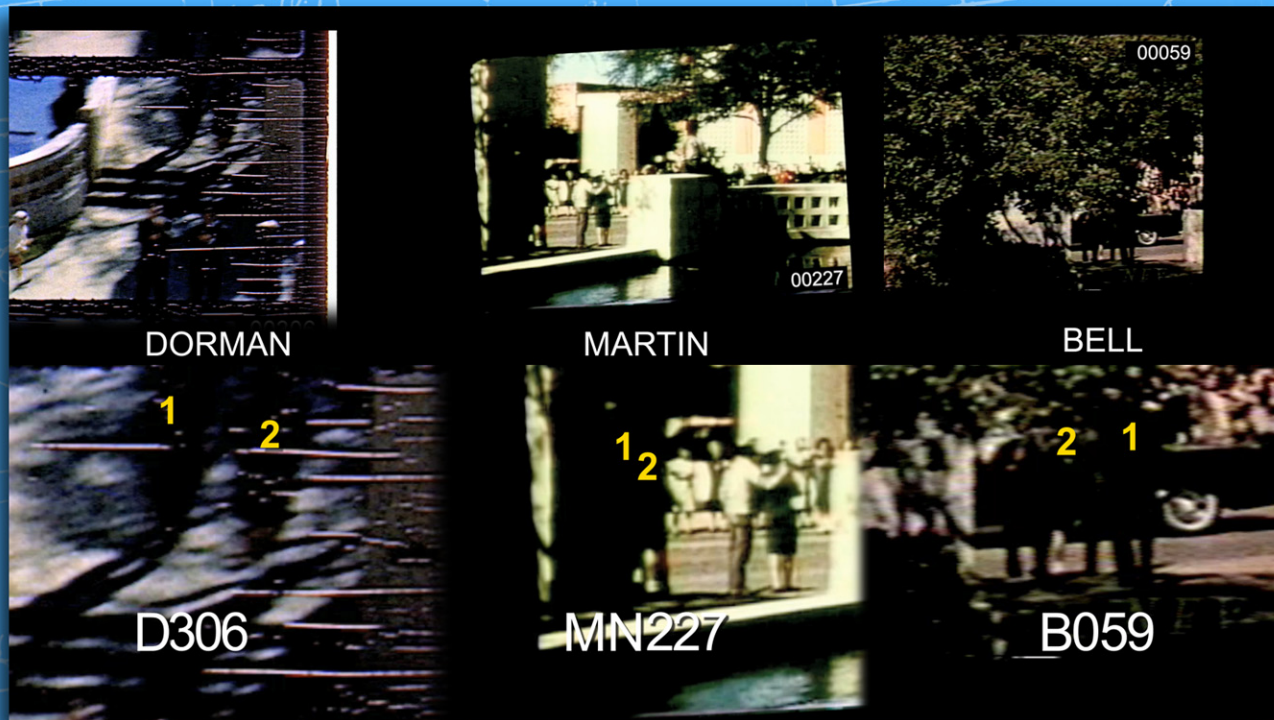


Exhibit 104. Synchronization between Towner and Bell – T110/B035 to T114/B039.



DORMAN-MARTIN-BELL SYNC - D304/MN224/B056 to D308/MN229/B060

Exhibit 105. Synchronization between Dorman, Martin, and Bell – D304/MN224/B056 to D308/MN229/B060.



TOWNER-MARTIN SYNC - T117/MN207 to T160/MN250

Exhibit 106. Synchronization between Towner and Martin – T117/MN207 to T160/MN250.

The three sequences can be synchronized by aligning the gait of the man as he takes each step. In particular, the man can be seen planting his right foot at Dorman/Martin frame D303/MN223 and his left foot at Dorman/Martin frame D310/MN232.

(VRP-9) Three individuals – a woman and two men – stationed along the north side of Elm Street near the west end of the Texas School Book Depository provides a synchronization point between Towner and Martin – T117/MN207 to T160/MN250.

In the Towner film, a woman [see *Exhibit 106*, No.1] standing along the north side of Elm Street can be seen raising her hand and waving vigorously between frames T130 and T160. This same action can be seen in the Martin film between frames MN220 and MN250.

The Towner film also shows a man wearing a dark coat and hat [no.2] raise his right hand and make a single snapping wave motion between frames T144 and T160. This same action can be seen in the Martin film between frames MN234 and MN250.

The Towner film further shows another man wearing a dark coat and hat [No.3] raise his left arm in salute between frames T130 and T137. This same action can be seen in the Martin film between frames MN220 and MN227.

A timeline chart was assembled to show the relationship between the nine visual reference points described above and how those reference points provide synchronicity between the Hughes and Zapruder films. [Film Synchronization – Visual Reference Points]

Alignment and Camera Frame Rates

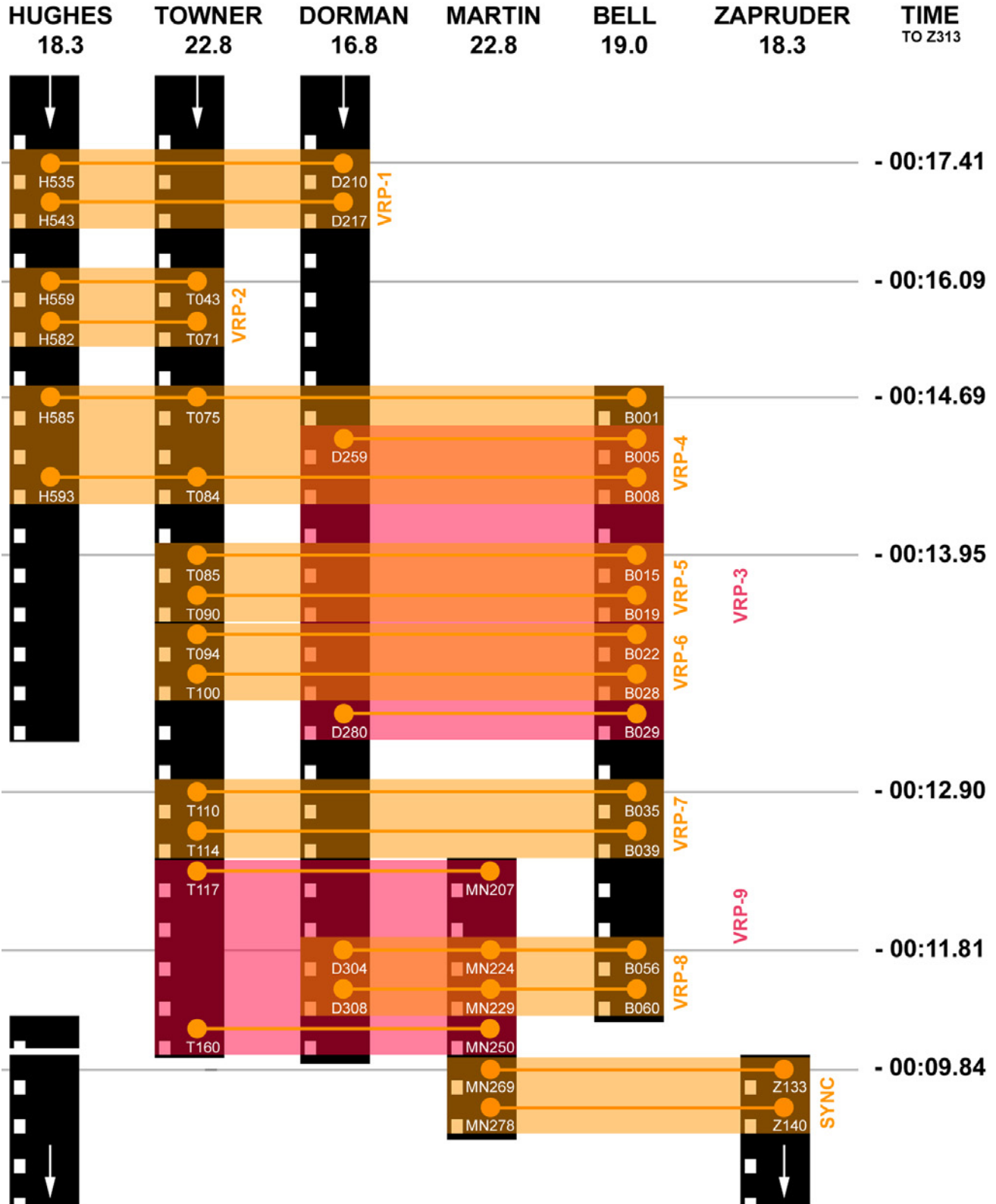
In order to keep the nine visual reference points described above aligned and in synchronization relative to each other and to the Zapruder film (+/- one frame), the following average per second frame rates were necessary:

| ZAPRUDER | HUGHES | TOWNER | DORMAN | MARTIN | BELL |
|----------|--------|--------|--------|--------|------|
| 18.3 | 18.3 | 22.8 | 16.8 | 22.8 | 19.0 |

AMATEUR FILM SYNCHRONIZATION TIMELINE

EPIPOLAR GEOMETRIC ANALYSIS OF AMATEUR FILMS RELATED TO ACOUSTICS EVIDENCE IN THE JOHN F. KENNEDY ASSASSINATION

VISUAL REFERENCE POINTS



JFK Assassination Film Synchronization / Visual Reference Points - Secrets of a Homicide: The JFK Assassination - Epipolar Geometric Analysis of Amateur Films Related to Acoustics Evidence in the John F. Kennedy Assassination © 2007 Dale K. Myers. All Rights Reserved. www.jkf.com

Amateur cameras of this era typically had standard running speeds of 16, 18, or 24 fps (16 and 18 fps being the most common) and operated within speed variations of 3 to 5% (or 0.5 to 1.0 frames).

Two of the average camera frame rates necessary to maintain synchronization are considerably outside of the variation expected for cameras operating at 16 or 18 fps – Martin and Towner.

The Martin camera was an 8mm DeJur, exact model unknown.¹⁴⁹ Some of the DeJur 8mm camera models allowed operating speeds of 12, 16, 24, 32, 48, and 64 frames-per-second. While the camera playback speed deduced from this analysis is outside of the variation expected for a DeJur camera model operating at 16 or 18 fps it would be within the expected variation associated with a DeJur camera model operating at 24 frames-per-second.

The Towner camera was a Sears-brand Tower Varizoom 8mm movie camera, model number 584.91250.¹⁵⁰ The Tower camera employed a three-way variable switch (labeled 'Animation – Stop – Run – Slow Motion') which allowed the operator to shoot a single frame of film (Animation), shoot film at a standard speed of 18 frames per second (Run), then change to a rate of 48 frames per second (Slow Motion) on the fly by simply pressing the run switch further down.

While the run switch was designed to allow the camera operator to film at standard and slow-motion speeds without stopping the camera, a slight amount of pressure downward on the variable speed switch will cause the film to shuttle faster through the film gate, increasing the frame rate in incremental amounts between 18 and 48 frames per second.¹⁵¹ This may explain why the frame rate is outside of the expected variation (+/- one frame) associated with the standard running rate of 18 frames-per-second.

Adjusting Camera Frame Rates

Adjusting any one camera's frame rate would of necessity alter the frame rates of all amateur films used in this study in order to maintain synchronicity.

FBI tests of Zapruder's Bell & Howell Zoomatic camera show a variation of about 3% from the standard run speed of 18 frames per second across a 60 second run time.

If the variations in the Zapruder camera speed are taken into account, the following frame rates would be needed to maintain synchronicity between all films:

149. Trask, Richard B., *Pictures of the Pain*, Yeoman Press, 1994, p.570; Report of FBI Interview of John Martin, Jr., April 2, 1964, p.1

150. Trask, Richard B., *Photographic Memory*, The Sixth Floor Museum, 1996, p.54

151. Author's examination of a duplicate model of the Sears-brand Tower Varizoom 8mm movie camera used by Towner.

| ZAPRUDER | HUGHES | TOWNER | DORMAN | MARTIN | BELL | MUCHMORE | NIX |
|----------|--------|--------|--------|--------|------|----------|------|
| 18.5 | 18.5 | 23.1 | 17.0 | 23.1 | 19.2 | 18.7 | 18.7 |
| 18.3 | 18.3 | 22.8 | 16.8 | 22.8 | 19.0 | 18.5 | 18.5 |
| 17.6 | 17.6 | 21.9 | 16.1 | 21.9 | 18.2 | 17.8 | 17.8 |

The results show that even when variations in the Zapruder camera frame rate are taken into account all films in this study (with the exception of Towner and Martin) are within the variations expected for cameras operating at 16 or 18 fps.

If the Towner and Martin cameras were operating at a standard 18 fps (a 21% decrease from the calculated rate), the following camera rates would be needed to maintain synchronicity between all films:

| ZAPRUDER | HUGHES | TOWNER | DORMAN | MARTIN | BELL | MUCHMORE | NIX |
|----------|--------|--------|--------|--------|------|----------|------|
| 14.5 | 14.5 | 18.0 | 13.3 | 18.0 | 15.0 | 14.6 | 14.6 |

The results show that when the Towner and Martin camera frame rates are set to a standard 18 fps all other films in this study (with the exception of Bell) would need to operate considerably below their expected variations in order to maintain synchronicity.

Since all nine of the visual reference points described above maintain synchronicity at the calculated frame rates relative to the Zapruder camera (+/- one frame), and since seven of the nine visual reference points involve the Towner and/or Martin films, then the relative frame rates of the Towner and Martin cameras must also be correct.

The higher than expected frames rates for the Towner and Martin cameras could be attributed to the initial camera speed settings or mechanical issues specific to the camera used.

APPENDIX V

CRITIQUE OF DONALD B. THOMAS' ANALYSIS OF PHOTOGRAPHIC EVIDENCE RELATED TO THE ACOUSTIC EVIDENCE

In March, 2001, *Science & Justice*, a quarterly publication of Britain's Forensic Science Society, published a paper by Donald B. Thomas, an entomologist¹⁵² and part-time assassination researcher working for the U.S. Department of Agriculture's Subtropical Agricultural Research Laboratory in Weslaco, Texas. Thomas became convinced of a conspiracy in the Kennedy assassination after viewing Oliver Stone's 1991 motion picture, *JFK*.

In his *Science & Justice* research paper, Thomas claimed that the 1982 Committee on Ballistic Acoustics' (CBA) report debunking the HSCA acoustic evidence was flawed and that a statistical review of the HSCA acoustic work confirmed their findings and elevated the probability of a grassy knoll shot from 95 to 96%. Thomas also claimed that five shots, not four as the HSCA had concluded, had been fired in Dealey Plaza.¹⁵³

Thomas' 2001 research paper and his subsequent writings and speeches on the subject, resulted in renewed debate about the validity of the HSCA's acoustic evidence of conspiracy. While Thomas supported the HSCA's conclusion that the assassination of President Kennedy was the result of a conspiracy, his own acoustic findings were at odds with virtually every acoustic conclusion reached by the HSCA about the shooting in Dealey Plaza.

First, Thomas believed that five shots, not four as the HSCA had concluded, were fired in Dealey Plaza. Second, Thomas believed that the five shots fired in Dealey Plaza were fired at times different than those specified by the HSCA. Third, Thomas believed that at least three gunmen, not two as the HSCA concluded, were firing at the president's motorcade. Fourth, Thomas believed that the fatal head shot was fired from the grassy knoll; while the HSCA concluded that a grassy knoll shot must have missed the motorcade entirely.¹⁵⁴

Since the photographic record proves that the acoustic evidence utilized by Thomas and the HSCA to support a conspiracy is invalid, the following section focuses on additional errors and omissions in Thomas' photographic analysis which he offered in support of the acoustic evidence, and hence, a conspiracy in the assassination of President Kennedy.

Many of Thomas' claims were factoids with little or no basis in fact. The following four assertions are addressed in no particular order of importance:

152. A person who studies the life cycles, behavior, ecology, or diversity of insects.

153. Thomas, D.B., "Echo correlation analysis and the acoustic evidence in the Kennedy assassination revisited," *Science & Justice* 2001, Vol.41, No.1, p.21-32

154. Ibid

(SEC-1) THOMAS' PROPOSED RE-TIMING OF THE FIRST SHOT FAILS TO PROVIDE OFFICER McLAIN SUFFICIENT TIME TO TRAVERSE THE DISTANCE REQUIRED FOR THE ACOUSTICS EVIDENCE TO BE VALID.

Thomas concluded in his 2001 presentation, "*Hear No Evil: The Acoustical Evidence in the Kennedy Assassination*," that the first shot was fired at the equivalent of Zapruder frame Z175, not Z160 as designated by the HSCA.¹⁵⁵

The proposal that the first shot was fired 0.82 seconds later than the HSCA hypothesized raises the question of whether a re-timing of the first shot would alter the conclusions drawn from the photographic record and presented in this document.

In other words, if McLain was indeed the officer with the open microphone and had an additional 0.82 seconds (for a total of 1.37 seconds) available to him to traverse the 174.38 foot distance between his last known location at the corner of Main and Houston and the microphone position dictated by the acoustic evidence, could McLain have made it to the microphone position in time to transmit the sound of the first shot at Zapruder frame Z175?

The answer is, *no*. As this paper has already demonstrated, McLain's last known position depicted in Hughes frame H648 is the equivalent of Zapruder frame Z150 (+/- one frame). If the first shot was fired at Z175, as suggested by Thomas, McLain would have 1.37 seconds ($175 - 150 = 25 \text{ frames} \div 18.3 \text{ fps} = 1.37 \text{ sec}$) to traverse the 174.38 foot distance between his last known location and the microphone position dictated by the acoustic evidence. In order to accomplish this feat, McLain would have to travel at a speed significantly greater than the maximum speed attainable using the motorcycle McLain was riding.

McLain's Harley-Davidson motorcycle was capable of a top speed of 95 mph. While McLain might have been able to cover the 174.38 foot distance in question in the allotted time at an average speed of 86.8 mph ($174.38 \text{ ft} \div 1.37 \text{ sec} = 127.3 \text{ ft/ps} = 86.8 \text{ mph}$), there are two other important factors that must be considered.

First, McLain's last known speed as depicted in the Hughes film was 14.7 mph. [See *Appendix II*, McLain in the Dorman Film, p.90] Second, the acoustic evidence dictates that the officer with the open microphone was moving at a speed of 10.5 mph between shots one and two.¹⁵⁶ Consequently, McLain would have to accelerate from a speed of 14.7 mph to a speed *much greater than* an average speed of 86.8 mph, then decelerate to 10.5 mph over the course of the 1.37 seconds available to him. How much greater than 86.8 mph would McLain have to travel down Houston Street?

155. Thomas, Donald B., "Hear No Evil: The Acoustical Evidence in the Kennedy Assassination," presented on 11/17/01 in Dallas, Texas, pp.6-7

156. This speed was later refined by Dr. James Barger to "about 8 mph." (Letter, Dr. James Barger to Norman Ramsey, February 2, 1982) A reduction in speed between shots one and two, as cited by Barger, would necessitate a considerable *increase* in speed, above and beyond the impossible speed already calculated.

Using computer models and a spline velocity curve, it was determined that McLain would have to accelerate to a speed of over 452.76 mph – more than half the speed of sound – in just 0.5 seconds in order to traverse the 174.38 foot distance in the allotted time and still match the known in and out speeds dictated by the Hughes film and the acoustic evidence. In short, it would be physically impossible for the Harley-Davidson motorcycle which McLain was riding to perform such a feat.

Setting aside the physical impossibility of such a feat, there is one common sense reason that weighs against the conclusion drawn by Thomas:

What possible motivation could McLain have for leaving his assigned position in the motorcade, the position he has occupied for the entire motorcade, and accelerate to a point nearly 180 feet forward of that position *before* any shots were fired? The reader will recall that the period under discussion is the 1.37 seconds *before any shots were fired at the motorcade*. Thomas' argument fails to offer a logical reason for this inexplicable action.

(SEC-2) THOMAS' PROPOSED TRAJECTORY AND SPEED FOR THE OPEN MICROPHONE FAILS TO SYNCHRONIZE WITH THE DALLAS POLICE RECORDING OR THE PHOTOGRAPHIC RECORD.

The radio transmission received from the motorcycle with the open microphone and recorded by the Dallas police demonstrates that the engine of that motorcycle was running at a *constant* rate during the two minutes prior to the impulse sounds designated as gunshots by the HSCA acoustic panel.¹⁵⁷

The first indication of a change in that constant rate occurs just 3 seconds before the impulse sounds thought to be “gunshots” are heard. At that time, the motorcycle engine slows down to about one-quarter of its previous rate. The motorcycle engine sounds continue at this lower rate for a period of about thirty seconds, then gradually increase in volume until they reach a maximum level equal to about 75% of the constant rate heard prior to the impulse sounds.

Thomas and the HSCA believed that the initial constant rate, the slowing of the engine and the gradual increase in rate corresponds to McLain's suspected approach to the Elm and Houston corner, his slow glide down Elm Street, and his eventual acceleration out of Dealey Plaza. Thus, Thomas and the HSCA believed the engine sounds are consistent with and supportive of the hypothesis that the open microphone was in fact in Dealey Plaza and transmitted the sounds of gunfire.

157. It is important to note that the *speed* of the motorcycle was never deduced from the sounds contained in the recording. However, the rate at which the pistons of the motorcycle fire does change over the course of the recording. Presumably, the rate of change relates to a change in speed.

However, there are numerous conflicts between the recording and the known progression of the motorcade before, during, and after the shooting that destroy the contention that the motorcycle with the open microphone was in the motorcade, and therefore, in a position to transmit the sounds of “gunshots.” Three instances of conflict immediately come to mind:

First, the Dallas police recording does not contain any auditory evidence of the kind of changes in engine rate that we know occurred during the two minutes *prior* to the shooting. For instance, we know the motorcade traveled down Main Street at a rate much slower than the average speed of 11.3 mph estimated by the FBI for the shooting sequence. Estimates by some motorcade officers put the speed on Main Street as low as 6 to 8 mph. News films clearly show this to be true and many officers testified to this fact. During the period on Main Street, the motorcycle escorts were also known to occasionally rev-up their engines in short bursts. Yet, there is no evidence of any of this on the audio recording which begins 2 minutes before the alleged gunshot sounds.

Second, we know from the photographic record that McLain accelerated to 14.7 mph as he rounded the corner from Main onto Houston – changing speed in order to maintain his position in the motorcade – yet, again, we don’t hear any evidence of this change in speed in the recording.

Third, even the Thomas\HSCA scenario dictates that McLain had to accelerate to an average speed of 17-20 mph (twice the average speed of the motorcade) as he traveled north on Houston Street in order to gain ground on the presidential limousine and make it to the position predicted by their acoustic analysis in time to transmit the sound of the first shot.¹⁵⁸ Yet, once again, we don’t hear any evidence of this change in speed on the recording. Instead, the recording shows the motorcycle engine to be running at a *constant* rate with no change in apparent speed.

If the motorcycle and open microphone are in fact part of the motorcade as Thomas alleges, why is there is no evidence of any of these events on the audio recording?

The conflicts between the Thomas\HSCA scenario and the acoustic recording are not limited to the moments leading up to the impulse sounds thought to be shots. Serious conflicts continue even after the supposed “shots” are fired.

For instance, the HSCA calculated that the open microphone was moving at a speed that was consistent with the average speed of the presidential limousine – 11.3 mph – at the time of the shooting. Both Thomas and the HSCA considered this fact significant. Thomas explained, “This is an impressive coincidence...Thus, the topographic order in the matching data is in remarkably close accord with the working hypothesis that a police motorcycle with an open microphone was traveling in the motorcade, northerly on Houston Street and westerly on Elm Street at a speed of around 11 mph when the President was killed by gunfire.”¹⁵⁹

158. Thomas, Donald B., “Hear No Evil: The Acoustical Evidence in the Kennedy Assassination,” presented on 11/17/01 in Dallas, Texas, p.8

159. Ibid, p.6

Both Thomas and the HSCA make a serious error in using average speeds to conclude that the open microphone was in close correspondence with the actual speed of the motorcade. James C. Bowles, the Dallas police radio dispatch supervisor at the time of the assassination and author of “*The Kennedy Assassination Tapes: A Rebuttal to the Acoustical Evidence Theory*,” a 1979 rebuttal to the HSCA findings, explained the issue succinctly when he told author Larry Sneed, “The limousine was not driven at a constant speed. This is another one of the things that was an inherent error in the House Select Committee’s scientific analysis. They calculated that the motorcade ran at an average speed of about 11 mph. I can show places in the Zapruder film where it went faster or slower. It did not travel at 11 mph at a constant rate. You can’t make averages serve you like a master. It’s a point of reference. In this type of situation, you had to deal with each occurrence as a matter of fact at the time it occurred.”¹⁶⁰

Computer analysis of the photographic record of the assassination sequence supports Bowles’ contention. The presidential limousine approached the Elm and Houston intersection at about 10.5 mph, slowed to 7.1 mph as it began the turn onto Elm Street, accelerated to 9.6 mph as it came out of the turn, and was traveling at about 10.5 mph when Zapruder began filming. The limousine was moving at 11.7 mph when Kennedy disappeared behind the Stemmons freeway sign, accelerating to 12 mph by the time it re-emerged from behind the sign. Suddenly, the limousine decelerated and was moving 8.9 mph at the time of the head shot.

Likewise, computer analysis shows other vehicles in the motorcade traveling on Houston Street at speeds varying from 7.1 to 9.9 mph as they follow the presidential limousine.

Computer analysis also shows McLain himself traveling at 14.7 mph as he rounds the turn from Main onto Houston (as seen in the Hughes film), slowing to 8.0 mph as he turns onto Elm Street (as seen in the Dorman film), and moving at 13.1 mph just before he leaves Dealey Plaza (as seen in the Bell film).

Even the Thomas scenario presumes that there were *six variations in speed* as the motorcycle with the open microphone made its way through Dealey Plaza. For instance, Thomas calculates that the open microphone accelerated to 17-20 mph as it traveled up Houston Street, slowed to 10.5 mph as the first shots were fired, sped up to 11.7 mph, slowed again to 11.0 mph for the fatal head shot, slowed again to an average speed of 4 mph¹⁶¹ for nearly thirty seconds, and finally accelerated out of Dealey Plaza.¹⁶²

160. Sneed, Larry, *No More Silence*, Three Forks Press, 1998, pp.180

161. A computer analysis of Thomas’ proposed scenario shows that McLain would have to slow to less than 2.0 mph in order to accommodate the presumed velocity of 11 mph during the last two shots, and the known velocity of 13.1 mph as seen in the Bell film. Any speed less than 5 mph would require the rider to place both feet on the ground to keep the motorcycle upright.

162. Thomas, Donald B., “Hear No Evil: The Acoustical Evidence in the Kennedy Assassination,” presented on 11/17/01 in Dallas, Texas, pp.7-9

Yet none of these measurable variations in speed are heard in the police audio recording. Instead of multiple variations in rate, the recording shows only *two* changes in rate – a single slowing, followed by a single acceleration.¹⁶³

Why doesn't the Dallas police audio recording reflect the constant acceleration and deceleration that the HSCA and Thomas insist occurred in Dealey Plaza?

The only reasonable answer is that the open microphone was *not* in Dealey Plaza. There are two reasons we know this is true. First, the 1982 National Research Council's Committee on Ballistic Acoustics (CBA) reviewed the work of the HSCA's acoustic team and concluded that the impulse sounds thought to be "gunshots" were actually recorded at least one minute after the assassination. Second, the photographic record conclusively demonstrates that no motorcycle was in a position to transmit the impulse sounds thought to be "gunshots."

(SEC-3) THOMAS' ACOUSTICAL SHOOTING SEQUENCE IS NOT SUPPORTED BY THE HSCA, THE TESTIMONY OF EYEWITNESSES, OR THE PHOTOGRAPHIC RECORD

While the acoustic experts hired by the HSCA determined that the Dallas police audio recording contained evidence of four gunshots, Thomas proposed that the Dallas police recording actually contains evidence of *five* shots. Thomas also claimed that the timing of the shots was different than the timing proposed by the HSCA. And most important of all, Thomas believed the fatal head shot was fired from the grassy knoll, *not* the Texas School Book Depository as the HSCA concluded. A necessary consequence of Thomas' belief that the fatal head shot was fired from the grassy knoll is a re-ordered shot sequence that begins later than the sequence proposed by the HSCA.

Thomas asserted that "The close agreement between the time sequence of impacts seen in the Zapruder film and the time sequence of gunshots on the police audio tape provides a basis for a coherent reconstruction of the crime."¹⁶⁴

However, those intimately familiar with the assassination evidence know that Thomas' shooting sequence is not in harmonious agreement, as he claimed, but completely at odds with the photographic record.

163. If one accepts for arguments sake that the motorcycle with the open microphone is in Dealey Plaza and that the slowest speed heard in the recording is consistent with the average speed of the motorcade through Dealey Plaza (11.3 mph), then the variations in rate heard on the recording would calculate to a constant rate of 45.2 mph prior to the shooting, 11.3 mph during and for thirty-seconds after the shooting, and an acceleration to 33 mph out of Dealey Plaza. If one presumes that the slowest rate on the recording is consistent with the slowest speed proposed by Thomas (4 mph), then the variations would calculate to a constant rate of 16.0 mph prior to the shooting, 4 mph during and for thirty-seconds after the shooting, and an acceleration to 12 mph out of Dealey Plaza. All of these scenarios are in conflict with the photographic record.

164. Thomas, Donald B., "Hear No Evil: The Acoustical Evidence in the Kennedy Assassination," presented on 11/17/01 in Dallas, Texas, p.23

In 1979, the HSCA acoustic experts concluded that four shots were fired from two sources – the Texas School Book Depository (TSBD) and the grassy knoll (GK) – in the following sequence:

| <u>HSCA FOUR SHOT SEQUENCE</u> ¹⁶⁵ | |
|---|---------------|
| Zapruder Frame | Firing Source |
| Z160 | TSBD |
| Z189 | TSBD |
| Z302 | GK |
| Z312 | TSBD |

Thomas, on the other hand, asserted the following five shot sequence, which includes an inexplicable “noise” heard immediately before the shooting:

| <u>THOMAS FIVE SHOT SEQUENCE</u> ¹⁶⁶ | |
|---|----------------------|
| Zapruder Frame | Firing Source |
| Z146 | Unidentified “noise” |
| Z175 | TSBD |
| Z204 | Rogue Shot |
| Z224 | TSBD |
| Z312 | GK |
| Z326 | TSBD |

Thomas described these six events in the following manner:

Z146 – “Noise”

Thomas began his analysis by concluding that an inexplicable “noise” occurred at the equivalent of Zapruder frame Z146.¹⁶⁷ Thomas failed to determine what this “noise” was or where it came from, although he described the effect it had on Governor Connally.

Thomas wrote, “Beginning at frame 165 Governor John Connally, sitting directly in front of the President, makes a rapid head movement 90 deg to his left, then turns completely around in the opposite direction to glance back over his right shoulder. In his testimony to the Warren

165. *HSCA Report*, p.81-82

166. Thomas, Donald B., “Hear No Evil: The Acoustical Evidence in the Kennedy Assassination,” presented on 11/17/01 in Dallas, Texas, pp.23-24; (Unidentified noise at Z146): Thomas, Donald Byron, *Hear No Evil: Social Constructivism & The Forensic Evidence in the Kennedy Assassination*, Mary Ferrell Foundation Press, 2010, pp.702-706

167. In his book, *Hear No Evil: Social Constructivism & The Forensic Evidence in the Kennedy Assassination*, (Mary Ferrell Foundation Press, 2010, pp.702-706), Thomas claimed the “noise” occurred at the equivalent of Z146 rather than Z147 (as proposed in 2001), speculating that it was either a starter pistol signaling multiple assassins to fire or that it was simply a motorcycle backfire that triggered the assassination shots prematurely.

Commission the Governor stated that he turned to look back in response to hearing what he believed was a gunshot.”¹⁶⁸

Anyone who consults the Zapruder film will see that Connally turns to his left in the range Z152-160; then begins a four-tenths of a second turn to his right beginning at Z163.¹⁶⁹ All of these actions *end* by Z170; they do not *begin* at Z165 as Thomas asserted. It is very important to note that Connally consistently testified that he turned to his right after hearing a rifle shot. Being an avid hunter, Connally was *certain* he had heard a gunshot – not an inexplicable “noise” as Thomas proposed – and believed that the rifle shot had come from over his right shoulder; hence his turn to the right.

Z175 – TSBD Shot

Thomas concluded that the first shot was fired at the equivalent of Zapruder frame Z175 and missed the limousine. Thomas claimed that the effects of that first shot can be seen in the Zapruder film a little more than a second later.

Thomas wrote, “In the sequence of frames 194 to 207 (at which point he disappears behind the sign) President Kennedy suddenly froze his waving hand and abruptly raised his right elbow which had been resting on the car windowsill. He then shook his head from right to left. During the same sequence, a young girl [Rosemary Willis] who had been running alongside the limousine, stopped abruptly and turned to look in the general direction of the Book Depository behind the limousine. Also during this sequence, Mrs. Kennedy, who was waving at the young girl, turned to look in the direction of the President.”¹⁷⁰

Again, anyone consulting the Zapruder film will find Thomas’ description to be largely false. The president is looking hard over his right shoulder when he begins to turn back to his left at Z200; a turn that continues through Z207 when he disappears behind the Stemmons freeway sign. At that time, he is still facing to his right; a position he maintains until he emerges from behind the Stemmons sign. Thomas’ claim that Kennedy “shook his head from right to left” is a distorted version of the HSCA Photographic Panel’s account. They wrote that “during frames 200-202, [Kennedy’s] head moves rapidly from right to left,”¹⁷¹ in the direction of his wife. But even the HSCA account is false. The president never turned to look at his wife before disappearing behind the Stemmons Freeway sign, as the HSCA reported.

168. Thomas, Donald B., “Hear No Evil: The Acoustical Evidence in the Kennedy Assassination,” presented on 11/17/01 in Dallas, Texas, p.16

169. The HSCA photographic panel, which examined an inferior copy of the Zapruder film, reported that Connally’s turn to his right “begins to occur in the vicinity of Zapruder frames 162-167.” (6HSCA17)

170. Thomas, *op.cit.*, p.16

171. *HSCA Report*, p.82; See also 6HSCA17 [Note: Calvin McCamy, a member of the photographic panel, testified that just before disappearing behind the Stemmons Freeway sign, the president turned “quite rapidly to the left.” Displaying the relevant Zapruder frames, Camy stated, “His head is now to the left...It is quite clear he is here now looking directly at his wife. He and his wife can be seen looking at one another in this sequence. He now goes behind the sign...” (2HSCA145) McCamy’s description of the Zapruder sequence is completely inaccurate.]

How could the HSCA make such a mistake? By today's standards, the 1978 HSCA panel was working with an inferior copy of the film. The Zapruder film frames available today in digital format are from the original source material and consequently are much clearer than those utilized by the HSCA. Thomas apparently repeated their error, adding his own set of distortions.

Thomas's description of Mrs. Kennedy's actions is equally false. First, the photographic evidence clearly shows that in the moments before the shooting Mrs. Kennedy *never* lifted her hand in a wave at anyone, let alone at Rosemary Willis, as Thomas suggested. Second, while Mrs. Kennedy does turn toward the president during the range Z190-200 (*not* Z194-207, as Thomas claimed), she had *already turned to her right by Z185*, and her reason for turning was very explicit. Mrs. Kennedy testified that she was looking to her left when she heard a "noise" that she thought was a backfire from a motorcycle; which was rather common during motorcades. Then suddenly, she heard Governor Connally yelling, 'Oh no, no, no!' And so she turned to her right.¹⁷²

The Governor's wife, Nellie, also testified that her husband yelled 'Oh, no, no, no!' immediately after the first shot.¹⁷³ The Governor himself couldn't recall if he said 'Oh, no, no, no!' after the first or second shot; but did remember turning to look over his right shoulder after the first shot.¹⁷⁴

The left-to-right actions of both Governor Connally and Mrs. Kennedy are seen in rapid succession between frames Z162 and Z185; first Connally turns (Z163-170), then Mrs. Kennedy turns toward Connally (Z168-185), and finally toward her husband (Z190-200). Both Governor Connally and Mrs. Kennedy are seen reacting *exactly* as they testified they did immediately after the first shot. This combined testimony, confirmed by the photographic record, is very powerful and supportive of a first shot *prior* to Z160.

172. 5H180

173. 4H147; 1HSCA40

174. 4H133; 1HSCA43 [Note: In 1964, Governor Connally told the Warren Commission that he made two statements after being hit by the second shot, "I immediately, when I was hit, I said, 'Oh, no, no, no.' And then I said, 'My God they are going to kill us all.' " (4H133) In 1978, Connally seemed to suggest that one statement was made before he was hit and one after. Connally told the HSCA, "When I was hit, or shortly before I was hit – no, I guess it was after I was hit – I said first. Just almost in despair, I said, 'no, no, no,' thinking how tragic it was that we had gone through this 24 hours, it had all been so wonderful and so beautifully executed. The President had been so marvelously received and then here, at the last moment, this great tragedy. I just said, 'no, no, no.' Then I said right after I was hit, I said, 'My God, they are going to kill us all.' " (1HSCA43) While Connally was understandably confused about when he made his statements, both his wife Nellie and Mrs. Jacqueline Kennedy testified that Connally's initial statement, 'Oh, no, no, no!' was made immediately after the first shot, and before the second shot. In 1964, Nellie Connally told the Warren Commission, "As the first shot was hit, and I turned to look at the same time, I recall John saying, 'Oh, no, no, no.' Then there was a second shot, and it hit John, and as he recoiled to the right, just crumpled like a wounded animal to the right, he said, 'My God, they are going to kill us all.' " (4H147) In 1978, Nellie repeated her account to the HSCA, "John had turned to his right also when we heard that first noise and shouted, 'no, no, no,' and in the process of turning back around so that he could look back and see the President – I don't think he could see him when he turned to his right – the second shot was fired and hit him." (1HSCA40) Mrs. Jacqueline Kennedy was also very clear in her 1964 testimony to the Warren Commission that Connally yelled 'Oh, no, no, no!' immediately after the first shot, "So I was looking to the left. I guess there was a noise, but it didn't seem like any different noise really because there is so much noise, motorcycles and things. But then suddenly Governor Connally was yelling, 'Oh, no, no, no.' ...So I turned to the right." [Asked whether she recalled one or more shots?] "Well, there must have been two because the one that made me turn around was Governor Connally yelling... But I heard Governor Connally yelling and that made me turn around, and as I turned to the right my husband was doing this [indicating with hand at neck]. He was receiving a bullet... And just as I turned and looked at him, I could see a piece of his skull..." (5H180)]

What happened to the shot fired at Z175? According to Thomas, the bullet missed the limousine and possibly skipped on down toward the Triple Underpass where it wounded eyewitness James Tague.¹⁷⁵ Thomas also believed that “shrapnel” from this fragmented missed shot imbedded in the rear of the president’s skull and was later interpreted as such in the president’s x-rays. According to Thomas, this early “wounding” caused the president to “flinch” and shake his head back and forth and exclaim, “My God, I’m hit!” a statement attributed to him by Secret Service agent Roy Kellerman, who was riding in the front seat. According to everyone else in the car, the president said nothing during the shooting.¹⁷⁶

Z204 – Rogue Shot

Thomas concluded that the second shot was fired at the equivalent of Zapruder frame Z204 and was fired by a second gunman located to the rear of the president’s motorcade; the exact location undetermined. Hence, Thomas called this the “rogue shot.”

Thomas wrote, “This shot seems to have caused Phil Willis to flinch, depressing his shutter button and exposing his famous photograph of the President’s limousine. However, because this shot occurs so close following the first shot, and so soon before the next shot, it could not have come from Oswald’s rifle, according to the U.S. Army Weapons Testing Branch. This is the rogue shot. I am unaware of any evidence that would support the hypothesis that a rogue bullet caused any wounds.”¹⁷⁷ In short, Thomas believed that this shot also missed the motorcade.

Where did the so-called “rogue shot” go, and who fired it? Thomas doesn’t seem to know, stating, “We really don’t know where it went. We don’t know where it came from.”¹⁷⁸

It is difficult to accept Thomas’ analysis given that his so-called “rogue shot” corresponds to the HSCA’s second shot which they concluded, based on the acoustic evidence, was fired from the southeastern most corner window of the sixth floor of the Texas School Book Depository. Their acoustical proof was *three* correlations with test shots fired from that location.

Thomas rejected their conclusions for two reasons. One, Thomas erroneously believed that Oswald’s rifle could only be fired once every 2.25 seconds. However, this is a fundamental misrepresentation of the facts. The 2.25 second figure comes from early FBI and Army tests in which subjects timed the firing of the rifle using only the scope. Tests conducted by the HSCA, however, proved that the rifle could be fired in 1.66 seconds using the iron sights rather than the scope.¹⁷⁹ Second, there is no obvious, observable indication of a shot being

175. “Unredacted Episode 4: Transcript of Interview with Don Thomas,” April 5, 2006, www.maryfarrell.org, p.9

176. Thomas, Donald B., “Hear No Evil: The Acoustical Evidence in the Kennedy Assassination,” presented on 11/17/01 in Dallas, Texas, p.24; “Unredacted Episode 4: Transcript of Interview with Don Thomas,” April 5, 2006, www.maryfarrell.org, p.8

177. Thomas, Donald B., “Hear No Evil: The Acoustical Evidence in the Kennedy Assassination,” presented on 11/17/01 in Dallas, Texas, p.25

178. “Unredacted Episode 4: Transcript of Interview with Don Thomas,” April 5, 2006, www.maryfarrell.org, p.9

179. *HSCA Report*, p.83

fired at Z204 of the Zapruder film. According to Thomas, either the shot missed or no shot was fired at all. Thomas embraced the latter, which enabled him to claim that a second gunman was firing at the president from behind.¹⁸⁰

Moreover, Thomas' claim that a shot fired at Zapruder frame Z204 caused Phil Willis to take his "famous photograph" couldn't possibly be true. The Willis photograph that Thomas refers to is Willis slide No.5, which the HSCA photographic panel determined was exposed at the equivalent of Zapruder frame Z202 – one tenth of a second *before* Thomas' proposed shot.¹⁸¹

Z224 – TSBD Shot

Thomas concluded that the third shot was fired at the equivalent of Zapruder frame Z224 and struck both Kennedy and Connally – the single bullet.

Thomas' acoustic evidence for the shot at Z224 is a test shot correlation *rejected* by the HSCA. In his final report, Dr. James Barger of Bolt, Beranek and Newman, Inc., wrote that this particular test correlation was determined to be a false alarm (i.e., *not* a real shot) "because it occurred only 1.05 sec later than earlier correlations also obtained from the TSBD. The rifle cannot be fired that rapidly. Since there are three correlations plausibly indicating the earlier shot, the one occurring 1.05 sec later must be a false alarm."¹⁸²

Why does Thomas accept what acoustic experts rejected? Thomas wrote that Professor G. Robert Blakey, the former chief counsel for the Assassinations Committee, and Dr. James Barger told him that HSCA members would have been "more easily convinced of the acoustics evidence if there were not a rogue shot. Dr. Barger admitted to me that the criteria for judging a 'false alarm' in this instance was 'ad hoc,' – which is Latin for 'bull-oney.' Some matches were judged to be false alarms because it would require an unrealistic microphone trajectory. That is not the case for the third [shot]. On the contrary, it falls exactly into the order required by the working hypothesis."¹⁸³

Thomas failed to acknowledge that it is his own *reshuffling of the shooting sequence* which leaves him without an acoustic shot to match up with the Zapruder film evidence of a single bullet hit at Z224 – an obvious bullet hit, second only to the obvious hit at Z313. In order to maintain his belief that the fatal head shot was fired from the grassy knoll, which every forensic pathologist who has studied the case rejects, Thomas was forced to find acoustic evidence of the single bullet hit that clearly occurred at Z224. Consequently, Thomas, who has no expertise in acoustic science or forensic pathology, resurrected a test correlation that was rejected by acoustic experts.

180. It should be noted that the HSCA's shot sequence synchronizes this shot with events seen in Z189, not 204. While there is no obvious support for a shot that struck at that moment either, the HSCA believed one had been fired because the HSCA had *three* test correlations fired from the TSBD that matched the impulse sounds that occur in the audio recording at the equivalent of Z189 and they were confident that Oswald's rifle could be fired in as little as 1.66 seconds.

181. 6HSCA44

182. 8HSCA105

183. Thomas, Donald B., "Hear No Evil: The Acoustical Evidence in the Kennedy Assassination," presented on 11/17/01 in Dallas, Texas, p.5

It should be understood that Thomas' ad hoc reasoning is not limited to the acoustic aspects of the assassination. For instance, although Thomas concedes that a single bullet could have gone through Kennedy and hit Connally,¹⁸⁴ he rejected the idea that Commission Exhibit (CE) 399 – the so-called “magic bullet” was the bullet responsible for the seven wounds produced in both men. Instead, Thomas postulated that CE567, one of the bullet fragments found on the floor of the limousine the night of the assassination and linked to the fatal head wound was actually a fragment of the single bullet that struck Kennedy and Connally at Z224.¹⁸⁵

Since CE567 was traced to Oswald's rifle to the exclusion of all other weapons, and Thomas rejected the forensic evidence that proves Kennedy's fatal head wound came from behind, as well as the Warren Commission and HSCA conclusions that Oswald fired that fatal shot; Thomas was forced to link that bloody fragment to another wound – hence, Thomas' conclusion that CE567 was actually the result of the single bullet hit at Z224.

Thomas didn't explain how CE567 escaped Connally's left thigh and ended up on the floor of the *front seat* of the limousine.

Z312 – Grassy Knoll Shot

Thomas concluded that the fourth shot was fired at the equivalent of Zapruder frame Z312 and struck Kennedy in the head. This fatal shot was, according to Thomas, fired from the grassy knoll – a conclusion rejected by *every* forensic medical panel that has ever reviewed President Kennedy's authenticated autopsy photographs and x-rays. Even forensic pathologist Dr. Cyril Wecht, an outspoken critic of the Warren Report and a supporter of a conspiracy in the Kennedy assassination, acknowledged that the photographs and x-rays conclusively show that the president was struck by *a single shot, fired from the right rear* of the limousine; not the grassy knoll located to the limousine's right front.

While the HSCA believed that a shot *had* been fired from the grassy knoll (based on the acoustic evidence, which has since been shown to be invalid by the 1982 Committee on Ballistic Acoustics and this analysis of the photographic record), they concluded that the shot was fired one-half second before the fatal head shot and that it missed the motorcade. They reached this conclusion after their forensic medical panel determined that there was no forensic support for a grassy knoll hit. Thomas, who has no expertise in forensic pathology, rejected their logic.

184. “Unredacted Episode 4: Transcript of Interview with Don Thomas,” April 5, 2006, www.maryfarrell.org, p.10

185. Thomas, Donald B., “Hear No Evil: The Acoustical Evidence in the Kennedy Assassination,” presented on 11/17/01 in Dallas, Texas, p.25-26

Blur Analysis Support for a Grassy Knoll Gunman?

Thomas largely based his proposed fatal grassy knoll shot on a re-evaluation of the “jiggle” or blur analysis conducted by the HSCA. The blur analysis theorizes that camera ‘jiggles’ caused by the natural human startle reaction to gunfire are responsible for many of the blurs seen in the Zapruder film. Thomas asserted that blurs seen concurrent with the fatal head shot begin too soon to have been caused by a startle reaction to a shot fired from the Texas School Book Depository, which was 265 feet away from Zapruder’s location. Simply put, the sound of a shot fired from the Depository could not have reached Zapruder in the time between its firing and Zapruder’s startle reaction, given the distance to Zapruder’s location. Thomas reasoned that the shot that caused the head shot blurs in Zapruder’s film must have been fired from a position closer to Zapruder; hence Thomas’ conclusion that the fatal shot was fired from the grassy knoll, just 53 feet from Zapruder’s location.¹⁸⁶

While ‘blur’ analysis has some basis in scientific fact (auditory-based startle reactions *can* cause blurs in filmed images), Thomas and others who have used ‘blur’ analysis to determine how many shots were fired in Dealey Plaza, fail to consider non-auditory sources as the cause of at least some of the blurs seen in the Zapruder film.

There are two possible non-auditory sources that might have produced blurs or ‘jiggles’ in the Zapruder film – erratic camera operation and a natural human reaction to visual stimulus.

First, the mere act of holding and operating a motion picture camera, especially one equipped with a telephoto lens, can cause the kind of jiggle or blurs seen in the Zapruder film. For instance, we know that Zapruder could not have filmed the president’s passing limousine from a stationary position. In order to cover the nearly 180 degree of exposed roadway, Zapruder would had to have repositioned his feet and twisted his torso as the limousine drove by. Any slight shuffling of his feet or shift in body position could easily have resulted in the kind of jiggles or blurs we see in the film.¹⁸⁷

In addition, Zapruder’s secretary, Marilyn Sitzman, was standing with Zapruder on the concrete pedestal. Zapruder had a sense of vertigo and Sitzman stood behind him to steady him; which means, of course, that Sitzman’s body was in contact with Zapruder. Any interaction between the two as Zapruder pivoted to film the passing motorcade could also have resulted in jiggles or blurs in the resulting film.

Second, the visual record itself can also serve as a possible source of jiggle or blurs. For instance, there are some erratic camera movements that occur when the president’s limousine disappears behind the Stemmons freeway sign. Zapruder, tracking the limousine with his camera, hesitates in panning his camera as the limousine disappears from view, then resumes

186. Thomas, Donald B., “Hear No Evil: The Acoustical Evidence in the Kennedy Assassination,” presented on 11/17/01 in Dallas, Texas, p.23; Thomas, Donald B., “Emendations,” 2003, pp.1-2

187. Zapruder himself noted the natural tendency for camera operators using a telephoto lens, as he did, to produce filmed sequences that are blurry because slight hand movements are exaggerated by the telephoto lens. [7H572]

following the limousine as it reappears from behind the sign. The result is one of the larger jiggles or blurs in the film.

Another visual jolt, surely capable of causing erratic camera movements, occurs at the moment of the head shot. Zapruder testified to being horrified by what he saw through the telephoto viewfinder.

While gunshots can cause startle reactions resulting in film blurs, so can other non-auditory sources. Consequently, it is impossible to say with any degree of certainty that a particular set of film blurs were caused by gunshots as opposed to erratic camera movements, visual stimulus, or any number of other non-auditory sources.

Eyewitness Support for a Grassy Knoll Gunman?

Thomas claimed that a grassy knoll shot was supported by the “majority” of eyewitnesses; writing, “Many witnesses, one of them Abraham Zapruder, testified to the Warren Commission that they thought the shot originated from the area known as the Grassy Knoll...Some individuals reported seeing a man with a .30-30 rifle running from the scene of the assassination.”¹⁸⁸

In reality, less than 12% of eyewitnesses thought the grassy knoll was the source of the shots. The HSCA reviewed the statements of 178 witnesses to the shooting. The results show that out of a majority who could establish a direction at all, a majority of 49 of them (27.5%) thought the shots came from the Book Depository, a *minority* of 21 (11.8%) thought they came from the grassy knoll, 30 (16.9%) thought they originated elsewhere, and 78 (43.8%) were unable to tell which direction the shots had been fired from.¹⁸⁹

Thomas’ five shot proposal has even less support from eyewitnesses. Less than 7 out of 178 eyewitnesses (4%) who gave statements believed that more than four shots had been fired. Thomas claimed five shots were fired. The vast majority, 132 out of 178 (74%), reported hearing *only 3 shots*.¹⁹⁰

Thomas’ assertion that Zapruder pointed to the grassy knoll as the source of the head shot is equally misleading. Zapruder made it clear that he did not know which direction the fatal shot came from. Twice Zapruder said, ‘No,’ when asked if he had an impression as to the direction the shots were fired from. He did say that when police ran into the area behind him he “assumed” the shots came from there; but that was an impression based on the actions of police and not on the sound as he heard it. According to Zapruder, “there was too much reverberation.” Zapruder added that he wasn’t even sure the first sound he heard was a

188. WCE 1974, p. 24; Thomas, Donald B., “Hear No Evil: The Acoustical Evidence in the Kennedy Assassination,” presented on 11/17/01 in Dallas, Texas, p.22; “Unredacted Episode 4: Transcript of Interview with Don Thomas,” April 5, 2006, www.maryfarrell.org, p.12

189. 5HSCA502

190. Ibid

gunshot. Only after the president's head exploded with the sound of the second shot did Zapruder realize that the sounds were gunshots.¹⁹¹

Zapruder also testified that the first shot was fired and he saw the president "lean over and grab himself," a reference to Z225 of his film.¹⁹² Zapruder then said that before he had a chance to organize his thoughts he "heard a second shot" and saw the president's head explode.¹⁹³ Zapruder doesn't recall hearing a third shot.

Thomas' suggestion that "some individuals reported seeing a man with a .30-30 rifle" running from the grassy knoll is completely false. The citation Thomas provided to support his claim is a page from the Channel One transcript of the Dallas police radio recordings. The transmission cited is a description of the Texas School Book Depository gunman who was seen firing what was described as a "30-30 rifle" from the southeastern-most corner window of the sixth floor. There are no credible eyewitness accounts that support a grassy knoll gunman, nor was any physical evidence establishing the presence of a grassy knoll gunman ever recovered.

Z326 – TSBD Shot

Thomas concluded that the fifth and final shot was fired at the equivalent of Zapruder frame Z326 and missed the motorcade entirely.

In a 2006 interview, Thomas stated, "I'm pretty sure that's the one that went over the limo and hit the grass over by the manhole cover over near by where Tague had been standing. This is the one that the witnesses said the police came over and someone dug a - claimed that they'd taken a bullet out of the grass. In fact, it was the day after, on Saturday that Carl Day, the forensic bureau fellow for the Dallas Police Department went out with a tape measure and measured the distance from the Book Depository to that spot. When reporters asked him what he was doing he said, 'Well, this is a place where we recovered a bullet.' So, I always figured that was the bullet they dug out of the grass, and was probably Commission Exhibit 399."¹⁹⁴

Thomas' statements are false and misleading. The manhole cover Thomas referred to was actually located along the south Elm Street curb, *not* the Main Street curb where eyewitness James Tague was located. The Dallas police denied that a bullet was recovered from the area of the Elm Street sewer cover, nor has any eyewitness, photograph, or film ever surfaced that supports this factoid that appears in some of the earliest assassination literature. Finally, the claim that Dallas police crime lab Lieutenant J. Carl Day told reporters he recovered a bullet near the manhole is another second hand factoid without any basis in fact. In fact, Day

191. 7H572

192. 7H571

193. Ibid

194. "Unredacted Episode 4: Transcript of Interview with Don Thomas," April 5, 2006, www.maryfarrell.org, p.11

told author Larry Sneed, whose book Thomas cites elsewhere in his research paper, that “they found nothing” where a bullet reportedly struck.¹⁹⁵

In his presentation *Hear No Evil: The Acoustical Evidence in the Kennedy Assassination*, Thomas concluded that “the sequence of gunshots identified by the acoustical evidence meshes closely with the sequence of victim reactions, including impacts, seen in the Zapruder film.”¹⁹⁶

Nothing could be further from the truth. Thomas had concocted a conspiracy theory in the Kennedy shooting by reshuffling acoustic evidence, ignoring the medical record, and misrepresenting the photographic record.

(SEC-4) THOMAS’ PHOTOGRAPHIC ANALYSIS CONTAINS FIVE CRUCIAL ERRORS.

Don Thomas made several attempts to find harmony between the photographic record and his belief that Dallas police officer H.B. McLain was in a position to transmit the sound of gunshots from Dealey Plaza, and thus, validate the acoustic evidence of conspiracy.

As this paper has already demonstrated, the photographic record shows conclusively that McLain could not have been in a position to transmit the sounds of gunshots, nor could any other motorcyclist in the motorcade, and consequently, the acoustic evidence of a conspiracy is invalid.

This section documents five crucial errors that Thomas made in his photographic analysis:

(1) Camera Car 1 is 15 feet in length.

Thomas reported that Camera Car 1, a 1964 Chevrolet Impala, was 180 inches (15 feet) in overall length, citing the 1964 Chilton’s Automotive Manual (the specific page was not mentioned). This is false.

The 1964 Impala had an overall length of 209.9 inches (17.5 feet).¹⁹⁷

195. Sneed, Larry, *No More Silence*, 1998, p.235

196. Thomas, Donald B., “Hear No Evil: The Acoustical Evidence in the Kennedy Assassination,” presented on 11/17/01 in Dallas, Texas, p.26

197. *Chilton’s Auto Repair Manual, 1964-1971*, Chilton Book Company, 1971, p.187; Gunnell, John, *Standard Catalog of American Cars, 1946-1975, Revised 4th Edition*, Krause Publications, 2002, p.182

(2) Camera Car 1 is on a line-of-sight drawn between the Hughes' camera and the northwest corner of the Records Building at Hughes frame H633.

Thomas reported that Camera Car 1 lies on a line-of-sight drawn between the Hughes camera¹⁹⁸ and the northwest corner of the Records Building in Hughes frame H633.¹⁹⁹ This is false.

Enlargements of Hughes frame H633, created from the original source material archived by the Sixth Floor Museum, Dallas, Texas; clearly shows Camera Car 1 to be north of a line-of-sight drawn between the Hughes camera position and the northwest corner of the Records Building.

The true position of Camera Car 1 was determined by using computer models to align a model of the 17.5 foot long 1964 Chevrolet Impala with Hughes' field-of-view. The result shows the right rear bumper of Camera Car 1 is 2.95 feet north of, and 0.66 feet west of the line-of-sight drawn between the Hughes' camera and the northwest corner of the Records Building; *not* on the line of sight as Thomas reported.

(3) Camera Car 1 traverses 73 feet between Hughes frame H633 and Zapruder frame Z220.

Thomas claimed that Camera Car 1 traveled 73 feet between Hughes frame H633 and Zapruder frame Z220. This is false.

Thomas' two previous errors (using an overall car length of 15 feet, rather than the correct length of 17.5 feet; and positioning the car on a line of sight between the Hughes camera position and the NW corner of the Records Building; rather than slightly north and west of that line) resulted in an incorrect measurement for the distance Camera Car 1 traveled between Hughes frame H633 and Zapruder frame Z220.

When correctly scaled computer models of Camera Car 1 are aligned to Hughes frame H633 and Zapruder frame Z220, the distance between those two exposures was determined to be 59.8 feet; not 73 feet as reported by Thomas.

198. Thomas reported that Robert Hughes' precise location at the time that he filmed the motorcade is "not known" and that his best estimate based on examining his film and a photograph taken by Charles Bronson is that Hughes was standing 8 feet south of the center line of Main Street and 14 feet west of the center line of Houston Street. Thomas's positioning of the Hughes camera is essentially correct. Using computers to align the Hughes' camera field of view with computer models of Dealey Plaza, I pinpointed Hughes' location as 8.83 feet south of the center line of Main Street and 15.5 feet west of the center line of Houston Street.

199. Thomas based his analysis on a frame identified as Hughes frame H20 – which was the twentieth frame of the third sequence shot by Robert Hughes in Dealey Plaza. As explained earlier, the entire Hughes film was renumbered for this project beginning with the first sequence filmed in Dealey Plaza. Hughes frame H20 corresponds to Hughes frame H633 (i.e., the 633rd frame exposed in Dealey Plaza). For clarity, all Hughes frame references hereafter will reflect the renumbering used for this project.

(4) Camera Car 1 traverses its own length in 21 frames (Z216-236) which calculates to a speed of 12.5 feet/sec (8.5 mph).

Thomas reported that Camera Car 1 traversed its own length (incorrectly described as 15 feet in length) between Zapruder frames Z216 and Z236 – a total of 21 frames. Thomas subsequently calculated that Camera Car 1 was traveling at 12.5 feet/sec (8.5 mph). Both of these calculations are false.

To determine the true speed of Camera Car 1 at approximately Z220; digital enlargements of the appropriate area of the Zapruder film were contrast enhanced and stabilized. It was determined from this enlarged and stabilized sequence that Camera Car 1 traversed its own length (established as 17.5 feet in length) between Z213 and Z236 – a total of 23 frames. Therefore the actual speed of Camera Car 1 at approximately Z220 was 13.89 feet/sec (9.5 mph).

(5) Camera Car 1 traverses the 59.8 feet between Hughes frame H633 and Zapruder frame Z220 in an estimated 6.2 to 8.3 seconds.

Thomas guessed that Camera Car 1 traversed the distance between Hughes frame H633 and Zapruder frame Z220 (incorrectly reported by Thomas as 73 feet in length) in 6.2 to 8.3 seconds based on the idea that Camera Car 1 was “most likely at or close to maximum speed” in the middle of the block between Main and Elm. This guesstimate is neither scientific nor accurate.

In order to determine the correct time interval between Hughes frame H633 and Zapruder frame Z220; the speed of Camera Car 1 prior to Hughes frame H633 was calculated based on the speed of the vehicle as seen in Hughes frames H614 to H631 – the sequence immediately before the one in question. Using computer models and visual inspection of the film itself, it was determined that Camera Car 1 was traveling at 11.83 feet/sec (8.1 mph) between H614 and H631.

Considering that the known speed prior to Hughes frame H633 was 11.83 ft/sec (8.1 mph) and the known speed at Zapruder frame Z220 was 13.89 feet/sec (9.5 mph), it was determined that Camera Car 1 was traveling at an average speed of 12.86 feet/sec (8.8 mph)²⁰⁰ and therefore traversed the 59.8 foot distance between Hughes frame H633 and Zapruder frame Z220 in 4.65 seconds; not the 6.2 to 8.3 second guesstimate ventured by Thomas.

200. 12.86 feet/sec is the average of the two known speeds of 11.83 and 13.89 feet/sec.

Consequence of Thomas' Accumulated Errors

The five errors Thomas made in his calculations led him to conclude that Hughes frame H633 was exposed 3.8 to 5.9 seconds before the time of Thomas' first acoustic shot;²⁰¹ the equivalent of somewhere between Zapruder frames Z67 and Z106.²⁰²

If Thomas had not made these five errors, he would have realized that Hughes frame H633 was actually exposed 2.19 seconds before the time of his first acoustic shot; and therefore was the equivalent of Zapruder frame Z135. This means that the last Hughes frame showing McLain – H648 – is the equivalent of Zapruder frame 150.

As already shown, the synchronization of Hughes frame H648 to Zapruder frame Z150 invalidates the acoustic evidence regardless of whether one accepts the HSCA's conclusion that the first shot was fired at Z160, or Don Thomas' own conclusion that the first shot was fired at Z175. In either case, no motorcycle could have been in the position dictated by the acoustic evidence to transmit the sound of "gunfire."

Additional Errors, Omissions, Misleading Statements and Contradictions

In his 2001 research paper, Thomas criticized Greg Jaynes' 1997 photographic presentation which synchronized Hughes frame H633 with Zapruder frame Z160 based on the angle of the seventh car in the motorcade, the Vice-Presidential Secret Service Follow-Up Car, as it turned onto Elm Street. Jaynes' analysis was the result of simply "eyeballing" the Hughes and Zapruder films and had no geometric or scientific basis.

Thomas wrote that the H633/Z160 synchronization was "probably not correct." Why? Thomas explained that the seventh car²⁰³ in question probably "began its turn prior to the point where it came into view of Zapruder's lens, and then because of the sharpness of the turn, had to make a second steering adjustment while in the intersection that is seen in the Zapruder film."²⁰⁴

Of course, Thomas' assertion has no basis in fact and defies common sense. The Secret Service car is following close to the rear bumper of the Vice-President's car, as depicted in both the Hughes and Zapruder films. What possible reason would the driver of the Secret Service car

201. Remember, Thomas shifts the first shot to Z175 – 0.82 seconds later than the moment (Z160) when the HSCA concluded the first shot occurred.

202. These pre-assassination frame numbers are for reference only and presume that Zapruder had recorded an unbroken sequence beginning at frame Z001. The first frame to actually show the president on Elm Street was Z133, which marks the beginning of the shooting sequence.

203. Thomas erroneously identified the Vice-Presidential Secret Service Follow-up Car as the "fifth" car in the motorcade throughout his research paper. Actually, it was the seventh car in the motorcade. [Vaughan, Todd W., *Presidential Motorcade Schematic Listing, November 22, 1963, Dallas, Texas*, 1992, p.9] Thomas' error is corrected throughout the discussions in this document.

204. Thomas, Donald B., "Hear No Evil: The Acoustical Evidence in the Kennedy Assassination," presented on 11/17/01 in Dallas, Texas, pp.8-9

have for pulling out of line and beginning the Houston to Elm turn *before* the Vice President's car immediately in front of him does? Thomas' explanation is a poor attempt to explain away an obvious problem – visual evidence that the Hughes and Zapruder films overlap or nearly overlap; which, of course, eliminates McLain's opportunity to get to the first shot position in time to transmit the sound of "gunfire."

In an effort to support his belief that McLain had enough time to get to the first shot position, Thomas used Camera Car 1, the tenth car in the motorcade,²⁰⁵ to calculate the correspondence between the Hughes and Zapruder films. Thomas concluded that the tenth car traveled 73 feet in 6.2 to 8.3 seconds (6 to 8 mph) between the exposure of Hughes frame H633 and Zapruder frame Z220. This meant that McLain had 3.8 to 5.9 seconds to get to the first shot position; time enough to cover the 180 foot distance traveling at an average speed of 20.8 to 32 mph.²⁰⁶ After Thomas factored in the accordion effect (i.e., the motorcade procession's tendency to bunch up at corners and stretch out between blocks), he imagined that "McLain's position in [H633] is likely closer to six or seven seconds prior to the first shot, in accord with Hughes' memory that the shots occurred [five] seconds after he stopped filming."²⁰⁷ Consequently, Thomas believed that Hughes frame H633 synchronized to Zapruder frame range Z47 to Z65; *not* Z160 as the early analysis estimated.

It's already been shown that Thomas made five serious errors in his analysis of the movements of Camera Car 1. [See above]

Thomas claimed in *Emendation* that his alignment of the Hughes and Zapruder films was supported by newsreel film shot by cameraman Malcolm Couch. Thomas noted that Couch, who was in Camera Car 3, the twelfth car in the motorcade,²⁰⁸ filmed McLain approximately 200 feet west of the tenth car's position at Elm and Houston. Thomas reasoned that "in the time it took [Car 12] to travel 200 feet from Main to Elm, McLain had traveled 400 feet. Therefore, [McLain's] average speed during the interval has to have been twice whatever [Car 12] was doing."²⁰⁹ Thomas calculated that Camera Car 3 was averaging 7 mph as it traveled north on Houston Street, while he estimated McLain's speed at 25 mph during the same period. Thomas concluded that McLain's estimated speed of 20-25 mph was therefore "in accord with both the acoustical and the filmed evidence." Thomas cautioned, however, that "these values are soft values, which is to say, they are inferences from observed data, not actual measurements, and therefore do not prove that McLain was in the right position to record the shots, only that he reasonable could have been."

205. Thomas mistakenly referred to Camera Car 1 as the "eighth" car in the motorcade throughout his research paper. Camera Car 1 is correctly identified as the tenth car in the motorcade. [Vaughan, Todd W., *Presidential Motorcade Schematic Listing, November 22, 1963, Dallas, Texas*, 1992, p.11] Thomas' error is corrected throughout the discussions in this document.

206. Thomas, Donald B., "Hear No Evil: The Acoustical Evidence in the Kennedy Assassination," presented on 11/17/01 in Dallas, Texas, p.9; Thomas, Donald B., "Emendations," January 2003, pp.2-3

207. Thomas, Donald B., "Hear No Evil: The Acoustical Evidence in the Kennedy Assassination," presented on 11/17/01 in Dallas, Texas, p.9

208. Thomas erroneously described the car Malcolm Couch was riding in as the tenth car in the motorcade throughout his research paper. Couch was actually riding in Camera Car 3, the twelfth car in the motorcade. [Vaughan, Todd W., *Presidential Motorcade Schematic Listing, November 22, 1963, Dallas, Texas*, 1992, p.12] Thomas' error is corrected throughout the discussions in this document.

209. Thomas, Donald B., "Emendations," January 2003, p.3

However, Thomas made a serious mistake in his analysis of the filmed record from which he then drew an erroneous conclusion. Thomas' reasoning that McLain must have been averaging twice the speed of Camera Car 3, based on McLain's position in the Couch film, *assumes* that both vehicles were constantly moving during the interval in question. In fact, they were *not* – Camera Car 3, the vehicle containing Couch, had come to a stop in front of the Texas School Book Depository about 6 seconds after the fatal head shot and remained there for approximately 15 seconds before continuing down Elm Street.

This fact is evident in the film made by Dave Wiegman, Jr., who was riding in Camera Car 1, two cars ahead of Couch. Wiegman was rolling film as the fatal head shot rang out. Six seconds later, Camera Car 1 stopped in front of the Depository and Wiegman jumped from the car, camera still rolling, and dashed on foot toward the pergola north of Elm Street. Fifteen seconds later, Malcolm Couch began filming from the rear seat of Camera Car 3. As he panned to his left, Couch captured Camera Cars 1 and 2. Camera Car 2 was stopped just in front of his position. Camera Car 1, just ahead of Camera Car 2, can be seen just beginning to pull away from where it had *stopped 15 seconds earlier*.

So, in fact, McLain's motorcycle and Camera Car 3 were *not* constantly moving as Thomas assumed. The filmed record proves that Camera Cars 1, 2 and 3 had all stopped in front of the Texas School Book Depository for a period of about 15 seconds immediately after the fatal head shot, effectively refuting Thomas' allegation.

Thomas' Analysis of the Motorcyclist Seen in the Dorman Film

The Elsie Dorman film shows a motorcycle officer arriving at the HSCA's first and second shot positions well after the fatal head shot. If the motorcycle officer seen in Dorman is McLain, as critics of the acoustic evidence contend and this analysis demonstrates, the acoustic evidence would be invalid.

Early supporters of the acoustic findings believed the Dorman film depicted McLain – identified by note papers that are visible clipped to the inside lower-left corner of his windshield – arriving at the positions dictated by acoustic shots one and two; until it was realized that the film was exposed well after the head shot. Acoustic supporters, like Thomas, have struggled to explain away the Dorman film ever since.

In his initial analysis, Thomas claimed that the motorcyclist seen in the Dorman film was actually officer Clyde Haygood. Thomas based his conclusion on an examination of a film made by Malcolm Couch. The Couch film shows Officer Haygood moving down Elm Street behind H.B. McLain and J.W. Coursen. According to Thomas' calculations, the Couch film corresponds to the moments immediately following those depicted in the Dorman film;²¹⁰ hence, the motorcyclist in Dorman is Haygood, not McLain.²¹¹

210. In fact, the Couch film begins 15.5 seconds after the Dorman sequence depicting the motorcyclist ends.

211. Thomas, Donald B., "Hear No Evil: The Acoustical Evidence in the Kennedy Assassination," presented on 11/17/01 in Dallas, Texas, p.9

Thomas subsequently claimed that the officer seen in the Dorman film was Haygood's escort partner, J.W. Coursen.

To support this interpretation of the Dorman and Couch films, Thomas turned to the testimony of McLain and Coursen. Thomas charged that McLain changed his initial testimony to the HSCA after he learned that his testimony supported the acoustic evidence. According to Thomas, McLain's new version of events had him stopping on Houston Street, looking through the holes in the reflecting pool wall, and seeing Mrs. Kennedy climb out onto the trunk of the presidential limousine.

Thomas wrote, "However, McLain's memory is contradicted by the recollections of J.W. Courson. Perhaps unaware of McLain's statements, Courson related to researcher Larry Sneed in [his book] *No More Silence*, that just as he turned the corner on to Elm Street he saw Mrs. Kennedy out on the trunk of the President's limousine. This event is seen in the Zapruder film about 2-4 sec after the head shot. Thus, Courson must have reached the corner at about the time of the head shot, and because McLain is well ahead of Courson in the Couch film, he must also have been on Elm Street at that time, as projected." ²¹²

In short, Thomas embraced Coursen's account because Coursen hadn't change his story, and thus, was more reliable. But is he?

Testimony of McLain and Coursen

A review of the entire testimonial record for McLain and Coursen shows the accounts of both men to be problematic and, in particular, that Thomas was less than candid about the supportive nature of Coursen's testimony than he led readers to believe.

To begin, H.B. McLain was interviewed four times over 18 years.

On September 26, 1977, during the very first interview that McLain gave to HSCA investigators – *before* testifying in public – McLain said that he was just completing his turn from Main onto Houston Streets when "he heard what he believes were two shots. He looked up towards the Texas School Book Depository (TSBD) and saw pigeons fly from the roof of the Depository. An order came over his motorcycle radio to proceed to Parkland Hospital." ²¹³

Curiously, McLain described his position at the time of the first shot *exactly* as was recorded in the Hughes film and that he heard the order from Chief Curry come over his *own radio*. The fact that this was McLain's initial statement following the original event 14 years earlier, and *before* he had listened to the Dallas police recordings or seen any photographs, should not be overlooked.

212. Thomas, Donald B., "Hear No Evil: The Acoustical Evidence in the Kennedy Assassination," presented on 11/17/01 in Dallas, Texas, pp.9-10

213. HSCA 180-10107-10184, Staff Interview of Hollis B. McLain, September 26, 1977, p.1

On December 29, 1978, McLain testified publicly before the HSCA that he heard only one shot when he was on Houston Street, approximately halfway between Main and Elm.²¹⁴ McLain further testified that at the sound of the shot he looked ahead and saw pigeons fly out from behind the Book Depository. After turning onto Elm Street, McLain heard Chief Curry say, “Head for Parkland Hospital.”²¹⁵ McLain couldn’t recall which channel his radio was set to that day. Gary Cornwell, deputy chief counsel, asked McLain, “Then it would be fair to state that since you neither have a distinct memory nor, in fact, recall using your radio, we simply can’t determine from your memory which of the two channels your radio may have been on at the time of the motorcade; correct?” McLain replied, “No, sir.”²¹⁶

What Cornwell failed to note is that if McLain heard Curry instruct officers to go to the hospital, he *must* have been listening to channel two – which the entire motorcade was tuned to that day. Doesn’t McLain’s recollection of the statements he heard that day constitute his “memory” of what channel his radio was tuned to? Not necessarily, according to the HSCA and acoustic evidence supporters.

Under questioning, McLain told HSCA deputy chief counsel Gary Cornwell that if an adjacent motorcycle was close enough to his own, it would be *possible* for him to hear instructions coming over the adjacent motorcycle’s radio. Unfortunately, McLain was not asked if it was *probable* that he heard Curry’s instructions coming from another radio on the day in question. While supporters of the acoustic evidence are quick to accept the explanation for McLain’s ability to hear Chief Curry’s instructions on Channel Two and still have his own microphone stuck open on Channel One, it requires one to also accept one of two improbable circumstances: One, that McLain’s radio was tuned to the wrong channel (Channel One) for the entire thirty-nine minutes before the shooting and didn’t realize he could not hear the instructions being given by Chief Curry coming from his own radio; or two, that McLain inexplicably switched to Channel One at periodic points throughout the motorcade,²¹⁷ the last time being two minutes before the shooting.

It also raises the question as to why the instructions McLain supposedly heard from a nearby radio were not recorded on Channel One as crosstalk. After all, the radio microphone were designed to pick up the sound of human voices over the sound of the motorcycle engine, and we know (even by Thomas’ assessment) that the motorcycle with the open microphone was running slow enough during the period in question to allow any nearby radio to be audible. Why didn’t the police recording capture the sound of the radio McLain supposedly heard?

214. 5HSCA629

215. 5HSCA630

216. 5HSCA630 [Note: The HSCA *did* have photographic evidence of which channel McLain’s radio was set to, however the evidence was never admitted into the record. During the exchange with McLain, Cornwell mentioned that one of the photographs taken at Parkland Hospital (JFK Exhibit F-674, 5HSCA633) seemed to show McLain’s radio set to Channel One (i.e., the toggle switch set to the left), but that the angle at which the photograph was taken could be distorting the actual position of the toggle switch. Cornwell suggested that a photo expert might be able to determine whether McLain’s radio was set to Channel One or Two, however, even if they did there would be no way to know whether the switch had been changed sometime after the assassination and before the photo was taken. (5HSCA636-37) What Cornwell failed to mention is that at least one other photograph the HSCA had, taken from a superior angle, clearly showed the switch on McLain’s radio set to Channel Two (i.e., the toggle switch set to the right). (See *Appendix II*, Exhibit 62, p.91) While the committee had prepared several exhibits to show which channel McLain’s radio was set to, none of those exhibits were admitted into the record.]

217. The open microphone can be heard in short bursts throughout the period of the motorcade.

But much more important than these two common sense arguments is the fact that the filmed evidence *proves beyond question* that no motorcycles were anywhere near McLain before, during, or after the shooting, and therefore, McLain couldn't have heard Chief Curry's instructions coming from anywhere but his own radio.

For instance, the Hughes film shows McLain's escort partner, Marion L. Baker, to be 45 feet away and slightly ahead of him as they turn from Main onto Houston Streets. Considering the crowd noise and the string of motorcade vehicles between them, it would appear highly unlikely that McLain could have heard Baker's radio at that distance. And yet, Baker is the *only* motorcycle officer close to McLain. Furthermore, the films and photographs that cover the seconds that follow the shooting don't show McLain in proximity to any other motorcycles from which he could have heard Curry's instructions.

In 1979, after the HSCA's final report was published, McLain told former radio dispatch supervisor James C. Bowles that he was on Houston Street in the middle of the block when he heard one shot and saw pigeons fly up from the TSBD. He was stopping or had stopped at the time. "I don't recall ever hearing the other shots – just one which I guess was the first." He looked through an opening in the decorative wall on the west side of Houston Street and saw Secret Service Agent Clint Hill running behind the presidential limousine and jumping onto the rear of it. Then Chief Curry radioed for everyone to go to Parkland Hospital. McLain turned on his siren. As he turned onto Elm Street, he saw Bobby Hargis trying to straighten up his motorcycle. By the time he reached him, Hargis was running up the grassy knoll. McLain then accelerated out of the plaza. McLain reiterated that he "never left Houston Street until after the chief said for us to go to the hospital and for someone to check the overpass." McLain added, "Had the committee [HSCA] staff told me what they had in mind it would have made a difference in my testimony. There were at least deceitful if not outright dishonest with me." ²¹⁸

Finally, in an interview conducted between 1987-95 with author Larry Sneed, McLain stated that after turning from Main onto Houston he caught up with the motorcade cars in front of him and stopped right by the side entrance to the old jail about midway between Main and Elm Streets on Houston. "I heard one very clear shot," which seemed to come from directly ahead of him. He looked up and saw pigeons fly from the roof of the TSBD. "I could see the limousine off to my left on Elm and saw Mrs. Kennedy crawling on the back of the car...About that time the chief came on the radio and said, 'Get to Parkland Hospital!' ..." As he sped down Elm Street, he noticed Bobby Hargis crawling on his hands and knees across the grassy knoll. McLain caught up with the limousine on Stemmons somewhere around the Continental overpass. Upon listening to the recordings in 1979, McLain declared that the open microphone was clearly mounted on a three-wheel motorcycle, not a two-wheel motorcycle like the motorcade escorts rode. The three-wheeler makes a distinctive sound. ²¹⁹

Obviously, McLain's account of the events of November 22, 1963, has changed over time, which is typical of eyewitness accounts. While Thomas was quick to dismiss McLain's testimony

218. Bowles, James C., *The Kennedy Assassination Tapes: A Rebuttal to the Acoustical Evidence Theory*, 1979, pp.139-141

219. Sneed, Larry, *No More Silence*, Three Forks Press, 1998, pp.163-166

because of the changes he offered over time, Thomas failed to be as critical of Coursen's account, which is at the very least equally contradictory.

J.W. Coursen was interviewed three times over the course of 16 years. During his first interview of record in 1979, Coursen told J.C. Bowles that he had just turned off of Main onto Houston and stopped just north of Main Street and waited for the White House Press bus (Motorcade Vehicle No.17) to complete its turn onto Houston Street when he heard three shots that "definitely came from ahead of me..." He looked to the west toward Elm Street and the direction of where the president's limousine should have been but couldn't see anything. Coursen then took off from his position on Houston Street, passed numerous motorcade vehicles, and turned onto Elm Street. He saw an officer, Bobby Hargis, on his hands and knees. The lead vehicles had already cleared the Triple Underpass. Coursen sped up and caught them on the access road to the freeway. He stayed with the presidential limousine all the way to Parkland Hospital.²²⁰

In this early account, Coursen reported that he didn't "see anything" when he looked toward the president's car after the shooting, a point that conflicts with the later account accepted by Thomas.

During a second interview in 1986, Coursen stated that he was two cars in front of the White House Press Bus, which places him near the fifteenth vehicle in the motorcade – Congressman's Car No.3. – approximately 100 to 120 feet behind McLain. Coursen indicated that he was on Houston; 60 feet from the Elm and Houston intersection. He heard three shots. He turned onto Elm Street and saw Secret Service agent Clint Hill jump onto the back of the limousine to assist Mrs. Kennedy who was on the back of the limousine. Coursen stated that he and McLain moved down toward the limousine and got on either side of the rear of the limousine – Coursen on the left; McLain on the right. Coursen stated that he caught up with the limousine before they reached the Triple Underpass.²²¹

In this second retelling, Coursen included two impossibilities in his account. First, he stated that he saw Secret Service agent Clint Hill jump onto the back of the limousine just as he arrived at the Elm & Houston corner. Yet, the Dorman film shows the motorcyclist that Thomas contends is Coursen arriving at the intersection well *after* Hill had jumped onboard the limousine. Second, Coursen claims that he and McLain caught up with the presidential limousine before they reached the Triple Underpass. Again, the Couch film proves that the limousine had cleared the Triple Underpass long *before* Coursen had traveled half the length of Elm Street.

In a third interview conducted between 1987-95 with author Larry Sneed, Coursen stated that after turning from Main onto Houston he had to stop "due to the limousine having to make a sharp left turn ahead on Elm which slowed the motorcade." While stopped, Coursen heard three distinct shots coming from a single location although he couldn't tell exactly where because of the echo pattern. The first two shots were closer together than the second

220. Bowles, James C., *The Kennedy Assassination Tapes: A Rebuttal to the Acoustical Evidence Theory*, 1979, Officer F, pp.126-127

221. Interview of J.W. Coursen by Todd W. Vaughan, 1986, pp.21-25

and third shots. Coursen tried to look to his left down into the plaza but couldn't see anything, then sped ahead to catch up with the president's car. As Coursen rounded the corner at Elm and Houston, he could see that the limousine had stopped and Mrs. Kennedy was on the back. A Secret Service agent helped her back into the car and the limousine took off. Coursen caught up with them as they entered the Stemmons Freeway ramp.²²²

It is this third retelling that Thomas embraces as truth, yet, it too has an insurmountable amount of problems. First, Coursen states that he stopped on Houston just north of Main "due to the limousine having to make a sharp left turn ahead on Elm which slowed the motorcade." Yet, the Hughes film shows that the limousine had already turned onto Elm before McLain (who was 100 to 120 feet *ahead* of Coursen) had even reached the Main and Houston crosswalk. Consequently, Coursen must have been still on Main Street, approaching Dealey Plaza, when the presidential limousine made its turn onto Elm. Second, Coursen recalled hearing three shots from a single location; *not* the five shot scenario from two or more locations advocated by Thomas. Third, Coursen stated that after the three shots he looked down into the plaza, couldn't see anything, and then sped ahead to the Elm and Houston corner from where he could see that the presidential limousine had stopped, and a Secret Service Agent was assisting Mrs. Kennedy back into the car. Of course, the limousine *never* stopped on Elm Street, as the Zapruder film proves.

What's important to note is the conflict in the timing of the sequence Coursen proposes versus the one advocated by Thomas.

You'll recall that the Dorman film shows the motorcyclist (identified by Thomas as Coursen) *slowly* approaching the Elm and Houston intersection just 2.95 seconds *after* the fatal head shot. How could Coursen's account possibly be true if he is indeed the officer in the Dorman film, as Thomas asserts? Coursen claimed he was stopped on Houston 180 feet from the Elm and Houston intersection when he heard three shots. A short period of time elapsed, as Coursen looked down into the plaza. Unable to see anything, he then – and *only* then – accelerated across the 180 foot distance to reach Elm and Houston. How could all of that have happened in 2.95 seconds?

The filmed record shows both McLain and Coursen's accounts to be inaccurate, which is not surprising given the passage of time. Eyewitness accounts are notoriously incomplete and contradictory. That is why the filmed record and scientific evidence outweigh human recollection.

Allegations that the Photographic Record is Ambiguous

In 2001, Thomas concluded, "The bottom line is that the film evidence is not definitive with regard to whether McLain was or was not in exactly the right positions required by the acoustical evidence because we simply do not have pictures showing these positions when

222. Sneed, Larry, *No More Silence*, Three Forks Press, 1998, pp.127-129

McLain is predicted to be there. However, if McLain was in continuous motion between where the motion pictures by Hughes and Couch show him to be, he would have been at least close to the predicted positions...”²²³

Thomas’ insistence that the photographic record is too ambiguous to answer the question as to whether McLain was in the right location at the right time to transmit the impulse sounds thought to be shots is false and misleading.

The Kennedy assassination is arguably the most photographed murder in history. There is an abundance of films and photographs available to determine the truth in a definitive manner, assuming of course that someone has the time and inclination to do so.

The HSCA failed to explore the photographic record adequately enough to answer the question largely because they ran out of money and time to do so. Thomas, and other supporters of the acoustic evidence, have had the resources available to them to answer the question of McLain’s position at the time of the shots but have failed to do so for reasons only they know.

The epipolar geometric analysis presented herein, makes it abundantly clear that the record is *not ambiguous*, as Thomas contended. As expected, the nine amateur films that captured the presidential motorcade’s journey through Dealey Plaza synchronize in only one way and that synchronization proves conclusively and beyond any doubt that no police motorcycles – including Officer H.B. McLain’s – were anywhere near the locations predicted by the HSCA’s acoustic experts, and consequently, the committee’s acoustic evidence of a conspiracy in the Kennedy assassination is invalid.

223. Thomas, Donald B., “Hear No Evil: The Acoustical Evidence in the Kennedy Assassination,” presented on 11/17/01 in Dallas, Texas, p.10

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