Materials Management Planning and Design
Planning the 21st Century Campus

KLEINFELDER
Bright People. Right Solutions.

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About Kleinfelder Higher Education Segment
Kleinfelder focuses on serving colleges and universities throughout the United States. We support traditional engineering strengths with skills that address elements of the “invisible campus” such as underground utilities, stormwater management, and Materials Management. We create teams of in-house specialists to find sustainable solutions that improve the campus environment and integrate above- and below-ground systems. We offer the following services: campus planning; Materials Management planning and design; roadway design and streetscape planning, environmental planning and design; and 3-D Modeling.

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CASE STUDIES:

Harvard University: Allston Campus
UMass Amherst: Southwest Residential Area
Brown University: College Hill
Columbia University: NW Corner Science Building
Harvard University: Law School
Massachusetts Institute Of Technology: Stata Center
University Of Pennsylvania: Annenberg Center
Yale University: Science Hill
UMass Amherst: Southwest Corridor, Modeling
Stanford University: School Of Medicine
Harvard is planning and has begun to build a new campus on a 208-acre site in Allston, across from the University’s main campus in Cambridge and adjacent to the Harvard Business School. The campus will be developed in phases over several decades and will comprise 10 million square feet of space and cost more than $10 billion. Kleinfelder was selected to act as the On-Call Architect/Engineer/Planner for the development, and our first assignment involved planning consultation for the underground systems including campus-wide Materials Management planning and the infrastructure master plan. Harvard’s goals for the study included:

- Establish an overall servicing plan, integrated service infrastructure, and operational support
- Develop a Materials Management (MM) system to support the academic and research mission of the University
- Support Harvard’s Green Campus Initiative through enhanced recycling, reduction of CO2 output, and maximizing green space

Kleinfelder thoroughly studied the draft of the proposed Institutional Master Plan, interviewed academic divisions proposed to relocate to Allston, maintenance personnel, and consultants. Actions recommended to meet the goals of the Master Plan were:

- Sister materials handling and utility infrastructure, when feasible, to minimize cost
- Group buildings into five, below-ground service catchment areas of about 2 million sf each
- Develop underground service nodes and distribution tunnels to accommodate full build-out in each district
- Install freight elevators in each complex with easy access from the horizontal tunnels
- Devise a proactive MM operational strategy for entire campus
**ACHIEVEMENTS AND OUTCOMES**

- Reduced service traffic and enhanced campus green space
- Reduced noise and odors while enhancing views
- Ensured efficient service node placement, size, and operations
- Increased pedestrian safety and security
- Reinforced Green Campus Initiative and contributed to LEED certification
- Provided design guidelines for service systems for future capital projects
CLIENT NEEDS

Much of the 1,400-acre UMass campus was constructed in the 1960s and 70s. As a result, many of the buildings and campus open spaces were in need of re-thinking and revitalization. The passage of several State bond bills provided funds for major capital expenditures. To inform and facilitate this process, UMass retained Kleinfelder under a “House Doctor” contract to provide insights into the following problems:

- How to achieve connectivity between an eclectic mix of campus architectural styles and open space environments
- How to enhance the landscape by clearly identifying paths for campus deliveries
- How to provide a safer pedestrian experience on the campus

KLEINFELDER SOLUTIONS

Kleinfelder began by researching the physical history of the campus and understanding circulation patterns for pedestrians, cars, and delivery vehicles, as well as University instituted parking procedures. We provided analytical insights and strategies in separate studies:

1. Campus Landscape Improvement Plan
2. Southwest Residential Area Study
Action items suggested by the Kleinfelder studies included:

- Creating vehicle-free zones on the campus
- Consolidating or camouflaging service docks in several campus areas
- Creating an identifiable pedestrian armature through the core campus
- Suggesting a “Memorial Walk” to provide an organized system for class memorials and other donor monuments

**Achievements and Outcomes**

- Provided a firm basis for integrating new building projects with the landscape
- Improved accessibility to major service nodes—both existing and proposed
- Encouraged preservation of open space at campus edges by infilling the campus core
- Upgraded entire pedestrian concourse connecting the Southwest Residences to the core campus
- Suggested safety improvements to pedestrian crossings and eliminated conflicts with vehicles
- Consolidated service areas and docks from 24 to 9, eliminating pedestrian and vehicle conflicts
The client’s 2006 report “Strategic Framework for Physical Planning at Brown University,” identified three interrelated principles. Because of the crucial importance of these principles, the entire Institutional Master Plan for Brown is organized around them. These principles defined Kleinfelder’s Materials Management mission:

- Develop an efficient campus circulation infrastructure
- Consolidate the academic core
- Move beyond College Hill

After studying existing circulation routes, vehicle delivery patterns and core service functions, the Kleinfelder team identified opportunities to reduce the number of service locations and create operations efficiencies. Our Materials Management framework plan included a variety of actions to support the Brown master plan:

- Clustering service points on campus to reduce loading docks and truck parking
- Removing trucks from public ways to improve pedestrian safety and reduce traffic congestion
- Creating regional “nodes” for core service functions and to streamline the need for dispersed facilities
- Reorganizing the management and movement of materials — solid waste, recycling, supplies etc. — to a planned system reducing required space and labor resources
ACHIEVEMENTS AND OUTCOMES

- Developed new circulation infrastructure fostering community and compatibility with Brown’s historic neighborhood surroundings
- Created additional real estate options in support of future expansions away from College Hill
- Improved vehicle circulation and traffic flow on campus and local Providence streets
- Preserved and enhanced campus green spaces
- Provided campus landscape improvements to support the principles of Brown’s master plan
- Eliminated inefficient and unsightly “Dumpster Alley” to allow creation of a campus walk
The new 14-story Northwest Corner Science Building offers the opportunity to foster an interdisciplinary science experience for Columbia students. Workable links between buildings for service and support and safe vehicle and pedestrian circulation paths are essential to fulfilling this ideal. This entire portion of the Columbia campus sits on a raised deck with a support and service corridor called "The Grove," located one story below. The University’s needs included:

- Creating a program that would ensure timely, safe materials deliveries to labs
- Achieving high standards of sustainability practices including recycling and waste management
- Reorganizing The Grove and eliminating inefficiencies, safety risks, and costs of current operations
- Unlocking new opportunities for collaboration and interdisciplinary research

Kleinfelder was retained to study alternative approaches to Materials Management and service functions for the new building and its surrounding science cluster. Our Materials Management Planning Study:

- Provided assessment of existing service infrastructure, vehicle traffic, and circulation needs
- Identified problem areas and defined support space needs for the new building and surrounding facilities
- Analyzed waste streams to better manage hazardous materials and promote consumer recyclables
- Developed operational concept alternatives and advanced a preferred physical concept for Columbia
Reorganized and redefined support spaces needed to support a more collaborative science campus

Developed dock management system to guide future deliveries and materials movement

Reduced total support space required, opening more space to potential academic use

Integrated Materials Management best practices and benchmarks into the long-term plan
The 250,000-sf Northwest Corner Project is the most significant new addition to Harvard Law School’s campus since architect H.H. Richardson designed Austin Hall in 1883. This building is expected to transform the Harvard Law School experience and shape the school for decades to come. The project presented some unforeseen challenges:

- Creating a temporary service area to replace existing services being eliminated by pending construction
- Incorporating a permanent Materials Management receiving and vehicle protocol program into the new complex
- Reducing adverse impacts on the surrounding Cambridge residential neighborhood

One of the most vexing issues was the existence of an “island” approach to shipping, receiving, and vehicle movement. Each building on the campus, and each department, had evolved their own system for vendors, logistics, and delivery. Combined with the constraints of the narrow Cambridge roads, the past practices could not work within the new Northwest Corner complex. Our solution involved:

- Modeling all current and projected truck movements within the Law School campus, based on data researched and verified by Kleinfelder
- Designing a temporary, central loading facility for use during the construction phase
- Challenging the assumptions and plans for vehicle/truck access to the new complex, and modifying the projected truck sizes and delivery routes based on reliable data
- Designing a new central loading facility in the new complex to meet its needs and presenting the new plan to multiple stakeholders
CALIFORNIA STATE UNIVERSITY: LAW SCHOOL

ACHIEVEMENTS AND OUTCOMES

- Redefined the access and delivery problem to create a long-term, functional resolution
- Identified vehicle types, sizes, and delivery schedules compatible with neighborhood
- Consolidated service areas and docks from three buildings into one
- Integrated Materials Management best practices into long-term logistics plan

ANALYSIS OF SERVICE VEHICLE MOVEMENTS
Envisioned as a milestone and signature building anchoring the East campus, the Stata Center replaced MIT’s beloved Building 20. In addition to Building 20’s role as an incubator of scientific discovery, it housed central support functions for the entire East campus: truck deliveries, mail delivery, waste management, and material storage. MIT’s short and long-term goals included:

- Create a new portal to the East campus and change the industrial nature of the surrounding environment
- Devise temporary service facilities to distribute service functions when Building 20 was demolished
- Create a longer-term solution for service and materials movement among East campus buildings
- Develop a service hub at Stata which would not interfere with 24/7 academic and research activities

The first and most important action was to define what was needed in the plan and how extensive a service network was required beyond the Building 20 site. We produced multiple alternative solutions for MIT, including:

- Gathering and summarizing background data from dozens of sources, then identifying gaps in data
- Developing benchmark and materials data to inform the planning process
- Planning support and design for new temporary central facility to replace Building 20 services
- Producing concept plan for Materials Management and a programmatic concept for Stata Center architects to use in designing the new building’s below-grade support spaces
- Mapping MIT’s underground tunnels, and expanding existing tunnel system with new spurs to place as much of the support infrastructure below-grade
- Designing elevator access to tunnel system; recommending electric vehicles for tunnel service network
ACHIEVEMENTS AND OUTCOMES

- Opened new underground service center in the five-story parking/service complex beneath Stata Center
- Composed service network below East campus, much of it using electric delivery carts inside tunnels
- Took an asset MIT already had—the tunnels—and organized it in a more beneficial, productive way
- Accelerated transformation of the Kendall Square/East campus community by removing truck traffic and creating a more pedestrian and retail-friendly neighborhood, adding appeal to adjacent R&D/office uses
Before the innovative four-story glass and wood signature building could take shape above ground, a complex underground design and construction program was needed to locate as much of the campus infrastructure as possible below-grade and out of sight. The priorities of the University included:

- Consolidating a patchwork of services previously provided to individual buildings at street level through alley ways, parking lots, and pedestrian paths
- Resolving considerable street-level conflict between pedestrians and service vehicles
- Maintaining the open space courtyard and finding opportunities to increase green space
- Upgrading utility services including electrical, gas, steam, and telecommunications

Our team applied a multi-disciplinary review of all the opportunities, constraints, and potential benefits, tapping into the firm’s architecture, traffic, civil, environmental, solid waste and utility expertise. Working to enhance and fulfill the design intent of the new Center, we provided a Materials Management plan to:

- Design a new below-grade, central services location and subsurface loading dock beneath the new Annenberg Center, with underground links to four separate buildings
- Allow for the design of a pedestrian “green” plaza space above the new service area
- Define service functions, vehicle sizes, circulation routes, and delivery protocols
- Provide properly sized, functional support spaces for delivery, compaction, solid waste removal, truck turn-around, and emergency access for all buildings within the study area

The solution maintains University of Pennsylvania’s historic resources.
ACHIEVEMENTS AND OUTCOMES

- Improved safety by relocating service functions and eliminating vehicle/pedestrian conflict
- Produced efficient waste management guidelines and facilitated increased recycling initiatives
- Increased green space along the 36th Street Walkway
- Addressed long-term utility locations and infrastructure improvements ahead of the construction phase, reducing schedule and cost impacts of multiple digs
- Improved environmental stewardship of the campus
The new facilities program effectively doubles the amount of science and lab space at Science Hill. This increase places additional volume demands on service support spaces, waste management, and vehicle access and circulation. Yale’s goals to achieve this program included:

- Consolidate/reduce support services space while doubling academic space
- Eliminate the conflict between pedestrians and service vehicles on the Science Hill campus
- Increase green space by reclaiming service space and consolidating core service functions
- Cut waste stream by 50% at Science Hill

By completing a thorough inventory of existing conditions, opportunities, and constraints, we were able to provide Yale with a plan and design to achieve significant real estate efficiencies at Science Hill including:

- Developing a plan for new vehicle service node locations to reduce truck traffic
- Defining service functions for each new building site and integrating functions to increase efficiency using less space
- Utilizing natural topography and hillsides to integrate services within “invisible” spaces
- Reconfigured campus service spaces to support safe pedestrian environment, including new pathways and courtyards
ACHIEVEMENTS AND OUTCOMES

- Made much of Science Hill’s service infrastructure invisible to students, faculty, and staff
- 71 percent increase in campus green space
- Reducing vehicle and roadway surface reclaimed surface real estate
- Functional clustering plan reduced vehicle service area entry points from 10 to 2
- Designing green roofs over all service nodes improved energy efficiency and aesthetics

Safe pedestrian environments and historic campus character were maintained through creating new pathways and courtyards.

ANALYSIS PLAN

FINAL DISTRICT LANDSCAPE PLAN
CLIENT NEEDS

The Southwest Concourse at UMass Amherst is the major pedestrian spine through a 19-building residential complex constructed in the 1960s. Major landscape improvements are proposed for this area as part of the University’s goal to increase green space by reducing the impervious surface from 70% to 30%. Kleinfelder is supporting this effort by providing cutting-edge technology to:

- Map underground infrastructure to facilitate the landscape improvements.
- Develop an engineering-accurate 3-D model of the proposed surface landscaping improvements along with the existing buildings and utilities.

KLEINFELDER SOLUTIONS

Using Autodesk Civil 3-D®, Kleinfelder created a 3-D model of all civil infrastructure running beneath the Southwest Concourse from 2-D survey files and scanned record drawings. This comprehensive model includes structures and conduits for all sewer, water, steam, telecomm, and other utilities. We also used Civil 3D® to create an accurate surface model including existing landscape features, roadways, and subgrade building elevations and employed Autodesk Revit® to create a Building Information Model (BIM) of the existing buildings using CAD floor plans and scanned building records. The resulting product gives UMass and the project team a comprehensive, accurate model of all building and civil assets—inventorying everything from rooftops to underground utilities.

Landscape options can be superimposed on the model allowing creation of 3-D animations and permitting the University to easily analyze different landscapes.
Created interactive, data-rich campus models valuable for planning, design, operations, and maintenance. These models will save UMass time and money, mitigate risk, and improve stakeholder involvement and collaboration.

Facilitated work of architects, planners, landscape architects, and operations personnel by enabling creation of designs based on engineering-/space-accurate data.

Created a model which can superimpose landscape options to facilitate analysis of different landscapes.

Aided in proactively addressing how to effectively institute BIM, 3-D Modeling, GIS, and other technologies mandated by government agencies plus sustainability best practices.

Equipped stakeholders to use the model for more precise strategic planning and budgeting.
CLIENT NEEDS

Stanford University’s School of Medicine (SoM) campus dates back to the 1950s and has experienced significant growth since initial construction. Each building making up the SoM historically had its own servicing point. Due to local zoning restrictions, campus expansion was limited to higher density development within the existing campus footprint. Greater density, diminished open space, and more congested travel corridors made the traditional servicing approach problematic. Following development of a new Master Plan, the SoM adopted a centralized campus servicing approach and constructed a central loading dock as the critical feature of their servicing infrastructure. We worked with Stanford to:

- Maximize the University’s existing underground tunnel system and integrate its new central loading dock facility into existing service infrastructure.
- Decrease surface traffic and minimize conflicts between delivery vendors, pedestrians, and other vehicular traffic on campus also emphasizing a pedestrian and bike-friendly environment.

KLEINFELDER SOLUTIONS

Kleinfelder reviewed existing utility surveys, conducted on-site evaluations, and performed a connectivity analysis to establish how the loading dock could be connected to the University’s existing tunnel system and vertical connective elements, i.e. stairs and elevators within individual structures. Through analyzing tunnel geometry and integrating modeling results, Kleinfelder identified the optimal size and type of mechanized equipment that could be used in the tunnel systems. We created maps to model traffic flow and turn-around capacity. We also integrated way-finding graphics, equipment/material security, and pedestrian safety features integrated into the resulting comprehensive operations plan that established Standard Operating Procedures for facility operators and vendors.
ACHIEVEMENTS AND OUTCOMES

- Alleviated congested conditions through central loading dock and decrease in vehicles at curbsides, sidewalks, and alleyways
- Created dedicated corridors and tunnels for vendors and contracts
- Reduced vendor trips, idling time, and emissions from delivery vehicles and improved waste and recycling procedures
- Provided means of collecting and analyzing the loading dock’s capacity, amount of truck traffic, truck idling time, collection efficiencies, and individual bay turn-over frequency rates through built-in data collection system
- Provided policies and vision for servicing a campus expected to add more than one million sf over the next decade

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**Exceptional Commitment To Quality**

Kleinfelder is an employee-owned architecture, engineering, and science consulting firm providing solutions to meet our world’s complex infrastructure and natural resource challenges. Working as a team, our bright people will deliver the right solutions.