



or Bob Brookover, Paradise is a gravel lot. Located near Memorial Stadium—Death Valley to millions of Clemson Football fans—it's a tailgating spot that's been in his family for years. It's where kids play catch and adults enjoy picnic food and drinks while relaxing on six Saturdays every fall.

Brookover, a PRTM senior lecturer, was concerned Clemson University was intent on paving his paradise and putting up a parking lot.

"Other than Holtzendorf and the tennis center lot, we have a band of grass from when you enter campus on 93 with Thornhill Village, President's Park, Bowman, Riggs, Lot 1, Lot 2A—all the way to the lake," Brookover said. "Putting a paved lot in 2A wouldn't really bring anything to the party from the perspective of easing parking issues and would detract from that nearly continuous green space."

University officials, however, had different priorities. With each additional football championship comes a demand for more tailgate spots. The University must maximize the number of parking spots in each lot. The graveled lot, 2A, doesn't have designated spots marked by traditional yellow stripes. It's a free-for-all on game days and school days. In addition, the lot doesn't have a formal traffic pattern, which means traffic can back up as drivers attempt to navigate in or out of their created parking spot.

Any design to pave Lot 2A would have to meet the University's needs and consider tailgaters' desires. Balancing the needs of all stakeholders is just one skill that civil engineering sophomores gained as they collaborated on this design.

This project, and others like it, are the basis for the Springer I course, which is the beginning of the newly adopted Arch Initiatives curriculum. Faculty explored this new curriculum model through an NSF grant called RED (Revolutionizing Engineering Departments.)



Professor Wayne Sarasua (right) leads Springer I students through Lot 15 on Clemson's campus to examine design challenges and conceptualize traffic flow.

Led by Wayne Sarasua, a Glenn Department of Civil

Engineering professor that specializes in site design and transportation operations, the student teams designed a lot that maximizes parking, while considering stakeholder feedback, water drainage, and construction costs and timelines.

"Paving a gravel lot will create drainage problems," Sarasua explained. "Students have to consider how that impacts the area while efficiently using the space available."

To the Revolution

f the previous project sounds like it's more complex than what sophomore civil engineering students typically design, it's because it is.

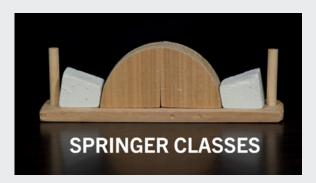
Arch Initiatives was developed by a team led by Jennifer Ogle, professor and department chair. The research team includes Brad Putman, former associate dean of undergraduate studies for the College of Computing, Engineering and Applied Sciences; Jesus M. de la Garza, professor and director of the School of Civil & Environmental Engineering and Earth Sciences; Lisa Benson, professor of engineering and science education; Russ Marion, professor of educational leadership; CJ Bolding, student services manager, and Sarasua.

"We are revolutionizing the delivery of civil engineering instruction at Clemson University," **Ogle said.**

Arch Initiatives disrupt the status quo and facilitate new forms of interaction between students, faculty, and industry partners. Beginning sophomore year, students take Springer I & II, which provides the foundation for successful teamwork, professional ethics, critical thinking, design processes, and professional formation as a civil engineer. Springer I introduces construction management, hydrology, and the site/transportation subdisciplines.

Springer II is the second in the two-course sequence and introduces students to the connection between structures, materials, and geotechnical subdisciplines. In a traditional engineering curriculum, students may not grasp the link between the information learned in class and its real-world application. Springers bridge that gap.

"The Arch brings problem-solving and design to the center of the curriculum while integrating crucial professional communication skills into our technical classes," said Nigel Kaye, Ph.D., a fluid mechanics professor.





Lecturer Omar Amer prepares a composite for strength testing.







Kaye is one of the four professors who teach Springer I as a team. The faculty team consists of a site and transportation professor, a hydrology professor, a construction management professor, and a communication professor. Professors rotate through the class, teaching their content one week a month. In addition to individual assignments within the subdisciplines, student teams complete team assignments that combine communication and technical content.

In Springer I, students work together to develop each segment of the project, consulting with the professors for content. Once the student teams have a conceptual design, they present their ideas to various stakeholders, which includes professional engineers and University officials, through a charrette. The charrette process provides an opportunity for the students to practice the public speaking skills they've developed by delivering individual speeches.

This is when Brookover and other stakeholders can share their concerns and make suggestions – such as providing more green space. The teams are tasked with incorporating that feedback into their final design. Stakeholder advice will often include the importance of developing strong written and oral communication skills.

Colin Kinton, P.E., recently served as a stakeholder for the site/transportation component of the students' designs in Springer I. Kinton, a senior project manager at Traffic, Planning and Design, Inc. in Asheville, always advises students to build their communication skills.

"I am often asked by engineering students what advice I can provide on which classes to take or what is needed to transition into a professional engineering career," he said. "My response is always to take more classes in technical writing or communications. I am always impressed with the technical competence of young engineers; however, technical competence is only about half of the pie."

Communication is a key component in the Arch Initiatives, which is why the department hired a full-time communication professor to coach and mentor students throughout their time in the department.

While Springer I focuses on oral communication, Springer II focuses on writing. Assignments build in complexity, helping students gain confidence and develop their writing skills through projects, including a field memo, cover letter, resume, and a team lab report.



ophomores receive additional care as they transition from general engineering into their specific majors. The department often loses students in the transition, especially underrepresented students. To combat this, the department created the CE-MENT peer-mentoring program. New students are paired with civil engineering juniors and seniors who help guide them through their journey. Through outreach and relationship-building, we hope to increase the diversity in our student population, department, and, eventually, the field.

"I became a CE-MENT mentor because I wanted to help create a stronger community within the department that I grew to love throughout my time here at Clemson. This program not only allowed me to interact with more people in the department, but it allowed me to grow and come out of my shell," said Eddie Lewis, a senior civil engineering student.

The CE-MENT mentoring program binds incoming sophomores to the department just like cement is a binding agent in Springer II. Strong concrete contains the right mixture of cement, water, and aggregates. Likewise, this course has a strong foundation built with the right ingredients: written communication, materials, geotechnical and structural engineering. These subdisciplines are brought together through a semester-long lab. The teams test the strength of different concretes, foundation sizes, foundation materials, and beam shapes. Through the testing, students gain insight into the failure mechanisms, structural mechanics, and material properties while also gaining technical writing skills.



"This program not only allowed me to interact with more people in the department, but it allowed me to grow and come out of my shell."

EDDIE LEWISRECENT graduate

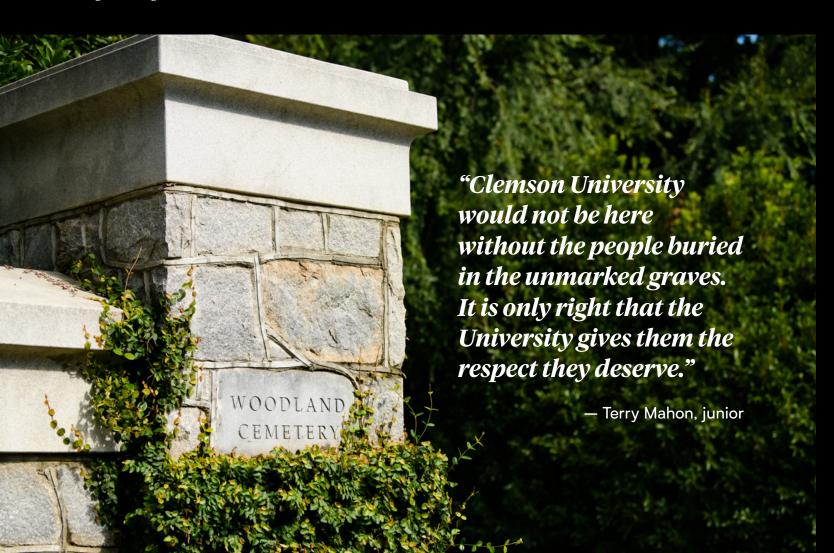
Shaping our World

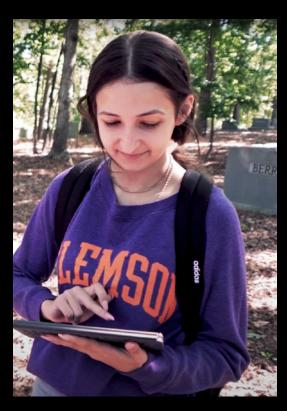
y their junior year, students are well-prepared to take on more challenging projects to meet the grand challenges facing our society. In three-hour studio block courses, the students design projects with a stronger emphasis on developing connections and creating stakeholder involvement.

A junior studio class recently accepted the monumental challenge to create a design for the Woodland Cemetery Historic Preservation project. The goal of the project was to recognize and preserve more than 600 unmarked graves. The students created aesthetically appealing designs that shared the complex histories of the enslaved people, convicted laborers, and employees who helped build the University. The students' goals involved more than designing a path that accounted for steep grades, stormwater run-off, and maintenance. In this process, students gained understanding of macro ethics – like how design contributes to gentrification of communities – and the roles they play as change agents.

Student teams collaborated with Rhondda Thomas, the Calhoun Lemon Professor of Literature, and community members to preserve the gravesites and honor all who are buried in the cemetery. Many of the unmarked graves are of enslaved men and women of color who helped build the University. Thomas and the historic preservation committee are ensuring those sites are properly maintained and recognized, and when possible, the personal stories are shared.

The junior studio goes beyond technical skills, inviting students to learn about complex societal issues with no clear answer. Students learn to develop solutions based on the community's needs and desires. The responsibility of learning and protecting leadership moves more toward the students. Emphasis is placed on using the strengths of the team to create value and collaboration.







CLOCKWISE from bottom left: Entrance to Woodland Cemetery. A student gathers data on the cemetery grounds. The 1965 aerial photo of <u>cemetery hill. A record of laborer names who helped build Clemson University.</u>

Students continue to build their communication skills through a variety of oral and written communication assignments, including client letters, social media posts, multi-media presentations, and field memos.

The Woodland Historic Preservation project provided an opportunity for students to step outside their often-narrow frame of personal reference. They gained an appreciation for the University's complex history and a new perspective on others' life experiences.

"Working on this Woodland Cemetery Historic Preservation project has been nothing short of a rewarding experience," said Terry Mahon, a junior. "Clemson University would not be here without the people buried in the unmarked graves. It is only right that the University gives them the respect they deserve."

Each team presented its design to University officials and aspects of the students' work are being considered in the final design.

You can view the students' work on the class Adobe Spark website.

1	ma smil	ALC: NO	1	TWELFTH CE		-	-			S. (Supervisor's Distri			В
8	comey bear	ner:	1 27	SCHEDU	JLI	E No. 1		0.00		Bromeration Dist	ist 3%	12-	} P
	Torruship or othe	or division of sounty	WAR.	THE PARTY OF PARTY OF THE PARTY.		serie benerotied	- Fam.	e of Institution, .	Office	a sprientist of		-	1.
94	Name of incorpo			above named division, 124	1000	war Adjududi	me very	-	-		- Ward	of oils.	X
		Das	awarated by t	me on the 4	day	of June, 1900,	year 1 ra	Morenau		, Deceroter.			215
-1	MONTHS.	7600	BILATUM.	PERSONAL DESCRIPTION.		P. Common A.	SATTISTY.	2.45	CTREES	D. COURSETING TRADE	08 E00	NEATHER.	MARKET C.S.
	E 1.	of each person whose phosi of phosis on plane 5, 1988, was		war likill	1 1		PARTY FORESTAND	grad, Dan and Street	1.151	of such person the vision of		TEL	TELL
	1 1 10 10	The state basely.	JEST CO	1 - 1	770		-125.02-	-12,22-	** (-	101	1 1	1 1
18	1 4 2 7				5 6				F. P				2 2 2
	1111	Chieferens 200	45,045	5" 86 Non- 179 Nr 4		A - W to dee	milloudia	4-20-1-		ov school		10 30	
6		Lauren ()	the date	20 12 may 1884 F 0		and broken	andtolin	book land:		Washing	2 4	JA 14	
		Barrette a 19	Sugar	te dic aux JW te C		South buchia	Anth tendie	front combine		abriehad		14 40	
N		Lauran & a.	student	15 155 June 1950 14 8		and soulis	hold trulie	hotel and in		at Ashart	9 4	ja ja	
-		Merine 2 H	Sheter	or 100 may 11/2 10 4	-	South Carolina	South land	deathlestin		et rebut	2 4	36 74	
2		Beile L.		b-10, and 892 / 0	-	brith boulin	And testin	Spridlenbia		wielne	1724	1/6 In	
1	-	Fairtre 7.a.	St. C.	20 12 12 12 12 12 12 12 12 12 12 12 12 12		hough boulie	La ofte 1	Total Secularia		it school	7 20	23.45	1111
10	15 83-64	Auchor bane	Prisere	5 make 112 mg 5		Acres & Smith				Orientes.	7 30	عر مر	
34		A A the		9 to 100 111 11 1		Inthe lawling	Lord mulia	doubt londing		Presinge		10 10	
M		Lored Grain	Continue.	1 25 Seek 187 21 18 3		Gooding Contin	South Carolia	had landing		Register	0 3	N 34	
41	-		Cinne	10 DE MR MAY 15 D		Acres Gerdin	Lord lands	hard bardin		Simon	1 24	Ja la	
68	1	Gred Samuel		0 10 W 10 237 10 /		dorth Andin	boath tender	Littlewhite	- 11	Richard	0 20	20.25	-
		Notice James	Parisona	BER OFFER	+	South landing	host out	hallandi.		Channel Comments	2 30	عامل	
		Johnston Johns		12 m day 197 22 5		Bratt andia				Octomia	0 30	10 10	
41		Fritzer en Germand	Prince	to the special property of		Batera	Bucheni	Manhori		Stand	0 14	34 50	100
**		Names and Asses	Borne	or occur inst by \$2.2		Anth mille	death tention	dallandia		Bakanan	0 3	36 Ja	
**	150	Brookinger will	Busine	1 12 de 1972 57 10		Bout Buckie	Amillandia	And legtin		Acres	0 12	20 10	16.5
20	100	wais augustus	Simo	12 Or Jan 150 25 9		Arath Broken	Amethica dia	And towning		Saline	2 3	26/26	100
15	1	What vere		9 36 546 (F) 34 A	-	Longth Beredia				Richards	-	10 10	100
15	100	Were Lucia		0 M. AF 179 JV.A		Local andia	Avail broken	Jane Charles		Reins		A 40	111
76		Lending Sugarors	Bureau	discissa well-		both Cerolia	Arath Cradia	Low Complian		China		100 m	
20	1000	Geed Dyles	Fireway	9 94 July 1900 W/ 18 5		Land Brown	Late Company	Aught Co. La		Action	0 30	Ja in	
20	6 - 60	Amoteu thirty	Bisam	S PA IND INT NOTE AT		Loubl Corplia				Bernste	0 3	4 24 4	100
0	100	whether Same	Simple	a 34 34 471 20 0		Arril Coupling				Connector		10 30	
6	100	Brigary Almin	River	6 75 may 100 10 d		Arrith and				Salar		44	
	1000	Robinson Briann		G RI Sain WAY 24 d		Arrell Carolin	Acres Sandia	down train		R.Z.		The Lite	111
5	4 2 0	assormer thick	Risemer	4 the base yearly to W		bostland	Latt broken	Antilladia		Reiman		La lie	
*	1000	meeting contilled	Prisente	a on over leasing by lay lo		South Carolina	And Court	boutle lie		Sulante		36 30	0.00
	14 02	House Chy	Cinner	4 14 Jan 1979 12 A		Swith Burkey	Borist Godge	Arrite Gardine		Simon	0 3	36.36	
0	124	Redform Donale for	Negelie	w M. Man Missey the 6	32	Arreth broken				Pryceinian	0 24	Sugar	RRA
-		- Armes	Am	or 10 may 1990 7 5	1	boath boules	Antil Studies	South londing	-		1 34	A 200	-
	Office Land		min alone	n. Tiply milus		hatt landing	Burth L. L.	Annal Continue					
-	2280	Martinen rolling	2621.4C	to the other was up to lat-		Gently Breatings	horth tradica	will trake		Referent Stating	1 30	ها عال ه	+ - 34
10	100	"The transfer	Seeks	Dr. P. Cong. 1889 40 18 18 18	55	Surt Contin	Anti broken	Aug St. Sampling		1	Lie	16 14	1 2 3
-	100	- making	change in	Per 17 (Briss, 1799) (\$1,4)		hough broken	Anth make	South Combine	100	Walnut		36 34	
0	100	- Rober	buck	1 17 442 117 12 d		dailbulie				W. selved	93	100	10
4	COLUMN TO SERVICE	- may	state to	10-17 20- 1981 11 0 10-10-20-21 1981 21 0	-	South broken	de Hardin	brilleda.		it school	17.1	45.00	100
16	22.22	Minery Garee Land	Niesto.	as the Lat. To surk clink it.		Antiladia		And Canhine		Filip duspied		JA DA .	A 2
168	10 15 16	Katto	+Mc	16 7 Stee WX 64 78 5	213	South Carolina				1	100	lin la	777
25	100	Assemble the	minule	100 00 100 100 15 15 15 15 15 15 15 15 15 15 15 15 15		Good Carolina	Authlowlin	millerdie	300	100000		0.5	ded.
H	100 200	- alike V.	mought	on G soprat (PF) 1 A to loss hop (PF) End		Louis Combine	broad limited	Last budde	8.45	P. P. C. St.	1 2	30.0	
	1 2 2	- New & Dr	NOW.	to the was 1999 Ent.		Louis Barrelia	and andias	but leading	2 15 6	1		1362	
25	1000000	None	Secretary	to the comments	ik	Mary down Bd	be inter	bridges.			100	402.171	106 1



point of pride—and a rite of passage for every graduate of the department—is the capstone course. Capstone remains a program highlight, but it's also evolving in our curriculum. The Keystone Design Experience is the crown jewel of the Arch Initiatives and brings together our students' technical and professional skills to create positive impacts on the world.

Maintaining a team and project-based format, students design theoretical projects on University property – including recreation centers, boutique hotels, conference centers, and study halls. Students are assigned a specific subdiscipline to lead throughout the design process. Each student then works with their consultant to create the best approach for their project. The team-based project teaches students how to effectively serve on a team and develop leadership and time management skills while meeting the project goal objectives. Professional and ethical responsibilities inform students' designs that also consider global, economic, environmental, and social contexts.

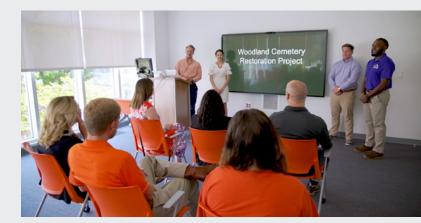
The projects may require students to travel across the state to observe civil engineering projects or to connect to communities and/or clients.

Industry leaders often partner with the Keystone faculty to develop a project that can truly impact the world before they graduate – creating value in the communities where they live and learn. In addition, industry leaders serve as external reviewers throughout the design process.

Technology and communication are integrated throughout the Keystone experience and are more essential in today's post-pandemic world. Through technology, civil engineers understand and design in complex and dangerous situations. These virtual experiences also offer students the opportunity to participate in situations that would otherwise be inaccessible.

Of course, no project is complete until the team can professionally articulate their concepts to the client. In Keystone, the students have ample practice in effectively communicating their ideas through proposals, client letters, presentations, and reports. The final project is a team presentation of their design.

After three years of intense design and communication training, students are prepared to join the workforce with the skills, understanding, and vision to create any client's version of paradise.



ARCH Initiative:Skills Gained





5

Self Awareness

- Individual strengths
- Personality traits
- Understand contribution to team dynamics
- Understand own working style and that of others



Building the Case

2021 By the Numbers

Undergraduates Enrolled

Graduates Enrolled

Faculty

Lecturers

Professor of Practice

FE Exam Passing Rate

Our Mission

To create an inclusive, supportive and engaging environment for our students to become professional civil engineers prepared to make a global impact. We partner with alumni and friends to underpin society by addressing its grand challenges, while proactively expanding our students' perspectives through scholarship, teaching, research, and outreach.

Our Values

- 1. Honesty, integrity, and transparency
- 2. Student-focused
- 3. Inclusive community
- 4. Professional service
- 5. Continuous Improvement and Innovation

Instilling Communications as a Core Skill



"I am often asked by engineering students what advice I can provide on which classes to take or what is needed to transition into a professional engineering career. My response is always to take more classes in technical writing or communications. I am always impressed with the technical competence of young engineers; however, technical competence is only about half of the pie. An engineer needs to be able to communicate their design effort to an audience that may include the client, team members, approval agencies and the public."

Colin Kinton, P.E.

Senior project manager at Traffic, Planning and Design, Inc.







Glenn Department of Civil Engineering Lowry Hall, Clemson SC 29634 P 864-656-3000 | www.clemson.edu/ce

