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SYSTEMS AND METHODS FOR A MODULAR DRAINAGE SYSTEM

Abstract

A modular drainage system is disclosed. The system comprises a central channel body having a trough, an outlet within the trough, and a flanged portion defining an open end. The central channel body further includes a first side wall and a second side wall extending upwardly from the trough, and coupling elements on each side wall. An extension channel body, also having a trough and coupling elements, is operatively coupled to the central channel body via a snap and press fit, creating a contiguous flow surface between the upper channel surfaces. The system may include an adjustable footer for leveling and an end cap for closure. Additional joiner channel bodies and non-linear channel sections can be incorporated to expand or adapt the system layout. The modular configuration allows for easy assembly, customization, and connection to existing drainage conduits.

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Background/Summary

REFERENCE TO RELATED APPLICATIONS [0001] This application is a non-provisional application which claims the benefit of the filing date of U.S. Provisional Application Ser. No. 63/553,906 titled “SYSTEMS AND METHODS FOR A MODULAR DRAINAGE SYSTEM” and filed Feb. 15, 2024 and the subject matter of which is incorporated herein by reference.

CROSS-REFERENCES
[0002] Not applicable.
STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT
[0003] Not applicable.
INCORPORATION BY REFERENCE OF MATERIAL SUBMITTED ON A COMPACT DISK
[0004] Not applicable.
TECHNICAL FIELD
[0005] The present disclosure relates to the field of drainage systems, and more specifically to the field of drainage systems designed for water management in various environments, including residential, commercial, and industrial settings.
BACKGROUND OF THE INVENTION
[0006] Traditionally, drainage systems have been constructed as monolithic structures, utilizing materials such as concrete, metal, or clay. These systems were designed to channel water away from buildings, pavements, and other structures to prevent water accumulation and potential damage. While effective in their primary function, these traditional drainage systems present several limitations that affect their adaptability, efficiency, and long-term viability.
[0007] One notable limitation is the rigidity and permanence of these systems. Once installed, traditional drainage systems offer little flexibility for modification or expansion, necessitating significant effort and expense for any alteration or upgrade. This rigidity poses challenges in adapting to changes in land use, environmental conditions, or water flow requirements.
[0008] Maintenance and accessibility issues further exacerbate the limitations of traditional drainage systems. The monolithic design and underground placement make inspection, cleaning, and repair difficult and labor-intensive. These challenges often lead to decreased system performance and increased risk of blockages and overflow, contributing to potential property damage and environmental impact.
[0009] Moreover, the materials used in traditional systems, while durable, are subject to degradation over time. Concrete can crack and erode, metals may corrode, and clay is susceptible to breakage. Such material vulnerabilities necessitate ongoing maintenance and can lead to premature system failure.
[0010] In response to these limitations, advancements in drainage technology have led to the development of modular drainage systems. These systems aim to address the inflexibility, maintenance challenges, and material limitations of traditional designs by introducing modularity, adaptability, and improved materials into drainage system construction. However, despite these advancements, there remains a need for further improvements in modular drainage system design to enhance installation ease, maintenance accessibility, system adaptability, and overall efficiency in managing water flow.
[0011] As a result, there exists a need for improvements over the prior art and more particularly for drainage system that offers easy installation, simple maintenance, and the flexibility to adapt to various configurations and environmental conditions, all while maintaining durability and efficient water management capabilities.

BRIEF SUMMARY OF THE INVENTION

[0012] A system and method for a modular drainage system is disclosed. This Summary is provided to introduce a selection of disclosed concepts in a simplified form that are further described below in the Detailed Description including the drawings provided. This Summary is not intended to identify key features or essential features of the claimed subject matter. Nor is this Summary intended to be used to limit the claimed subject matter's scope.

[0013] In one embodiment, a modular drainage system is disclosed. The system comprises a central channel body. The central channel body comprises a trough, an outlet in the trough, a flanged portion defining an open end of the trough, a first side wall and a second side wall each extending upwardly from the trough, and a first coupling element on each of the first side wall and the second side wall of the flanged portion. The central channel body further comprises a step defined by a riser between the flanged portion and an upper channel surface of the trough. The central channel body further comprises a first inner channel width between the first side wall and the second side wall of the flanged portion that is greater than a second inner channel width between the first side wall and the second side wall of the upper channel surface of the trough. The modular drainage system further comprises an extension channel body comprising a second trough, a first side wall and a second side wall each extending upwardly from the second trough, and a second coupling element on each of the first side wall and the second side wall. The system further comprises an assembled configuration having the extension channel body attached to the flanged portion of the central channel body such that the first coupling element of the central channel body is operatively coupled with the second coupling element of the extension channel body. A contiguous flow surface is defined by the upper channel surface of the trough of the central channel body and upper channel surface of the second trough of the extension channel body. An adjustable footer is coupled to the extension channel body in the assembled configuration. The modular drainage system further comprises an end cap having a third coupling element on the end cap operatively coupled to the second coupling element of the extension channel body in the assembled configuration.

[0014] In some embodiments, the extension channel body comprises a flanged portion at an open end of the second trough. In some embodiments, the extension channel body comprises the second coupling element on each of the first side wall and the second side wall at the flanged portion of the second trough. In some embodiments, the extension channel body defines a non-linear shaped trough.

[0015] In the assembled configuration, adhesive is disposed on at least a portion of the flanged portion and an abutting body of the modular drainage system. The first coupling element, the second coupling element, and the third coupling element are elongated. The first coupling element, the second coupling element, and the third coupling element each comprise a recessed portion and a projecting edge.

[0016] Additional aspects of the disclosed embodiment will be set forth in part in the description which follows, and in part will be obvious from the description, or may be learned by practice of the disclosed embodiments. The aspects of the disclosed embodiments will be realized and attained by means of the elements and combinations particularly pointed out in the appended claims. It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the disclosed embodiments, as claimed.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The accompanying drawings, which are incorporated in and constitute part of this specification, illustrate embodiments of the disclosure and together with the description, explain the principles of the disclosed embodiments. The embodiments illustrated herein are presently preferred, it being understood, however, that the disclosure is not limited to the precise arrangements and instrumentalities shown, wherein:

[0018] FIG. **1** is a top view of a modular drainage system, wherein the extension channel body is substantially linear, according to an example embodiment;

[0019] FIG. **2**A is a side view of the modular drainage system, wherein the extension channel body is substantially linear, according to an example embodiment;

[0020] FIG. **2**B is a top view of the modular drainage system including an angular extension channel body, according to an example embodiment;

[0021] FIG. **3**A is a perspective view of the central channel body, according to an example embodiment.

[0022] FIG. **3**B is a side view of the central channel body, according to an example embodiment.

[0023] FIG. **4**A is a perspective view of the extension channel body, according to an example embodiment.

[0024] FIG. **4**B is a front view of the extension channel body, according to an example embodiment.

[0025] FIG. **5**A is a front view of the extension channel body, according to an example embodiment.

[0026] FIG. **5**B is a top view of the extension channel body, according to an example embodiment.

[0027] FIG. **5**C is a side view of the extension channel body, according to an example embodiment.

[0028] FIG. **6**A is a front view of the angular extension channel body, according to an example embodiment.

[0029] FIG. **6**B is a perspective view of the angular extension channel body, according to an example embodiment.

[0030] FIG. **6**C is a top view of the angular extension channel body, according to an example embodiment.

[0031] FIG. **7**A is a side view of an adjustable footer body, according to an example embodiment.

[0032] FIG. **7**B is a top view of the adjustable footer body, according to an example embodiment.

[0033] FIG. **7**C is a perspective view of the adjustable footer body, according to an example embodiment.

[0034] FIG. **8**A is a perspective view of the end cap, according to an example embodiment.

[0035] FIG. **8**B is a front view of the end cap, according to an example embodiment.

[0036] FIG. **9** is a flowchart diagram illustrating the steps for a method of assembling the modular drainage system, according to an example embodiment.

[0037] FIG. **10**A is a perspective top view of a modular drainage system in the assembled configuration, according to an example embodiment.

[0038] FIG. **10**B is a perspective bottom view of the modular drainage system in the assembled configuration, according to an example embodiment.

[0039] FIG. **11**A is a top view of the modular drainage system in the assembled configuration, according to an example embodiment.

[0040] FIG. **11**B is a cross-sectional view of the modular drainage system in the assembled configuration, according to an example embodiment.

[0041] FIG. **12** is a flowchart diagram illustrating the steps for a method of assembling the modular drainage system, according to an example embodiment.

[0042] FIG. **13** is a flowchart diagram illustrating the steps for tailoring the length of the modular drainage system, according to an example embodiment.

[0043] Like reference numerals refer to like parts throughout the various views of the drawings. FIGS. **3** through **6**B are drawn to scale.

DETAILED DESCRIPTION

[0044] The following detailed description refers to the accompanying drawings. Whenever possible, the same reference numbers are used in the drawings and the following description to refer to the same or similar elements. While disclosed embodiments may be described, modifications, adaptations, and other implementations are possible. For example, substitutions, additions, or modifications may be made to the elements illustrated in the drawings, and the methods described herein may be modified by substituting reordering or adding additional stages or components to the disclosed methods and devices. Accordingly, the following detailed description does not limit the disclosed embodiments. Instead, the proper scope of the disclosed embodiments is defined by the appended claims.

[0045] The disclosed embodiments improve upon the problems with the prior art by providing a modular drainage system that offers modularity, adaptability, and ease of installation. The disclosure's modular design, characterized by the central and extension channel bodies with flanged portions and snap-fit connections (tracks and ridges), enables a highly flexible assembly process. This modularity allows for easy length adjustments and angular configurations, accommodating various site layouts and requirements. Unlike traditional fixed drainage systems, this modular system can be quickly adapted or expanded to meet changing needs without extensive modifications. The snap-fit mechanism for connecting channel bodies simplifies the installation process, making it faster and reducing the need for specialized tools or skills. This contrasts with prior systems that often require welding, bolting, or the use of adhesives, which can be time-consuming and require professional installation services. The inclusion of adjustable footers with height and leveling elements represents an advancement in ensuring proper drainage system alignment and slope. This feature allows for fine-tuned adjustments to accommodate uneven ground, ensuring efficient water flow towards the outlet. Prior systems may lack this flexibility, leading to potential issues with water pooling or inefficient drainage. The system incorporates a grate for water ingress, designed to prevent large debris from entering the drainage channel. This improves over prior art by providing a removable solution for easy cleaning and maintenance, enhancing the system's longevity and performance. The end caps with snap-fit mechanisms improve the system's aesthetic and functional integrity by providing a neat and secure finish. This feature also helps in preventing debris ingress and water leakage at the system's ends, an area where prior systems may have vulnerabilities.

[0046] The modular drainage system presents several improvements over the prior art, addressing critical limitations in existing designs. One significant improvement is the incorporation of coupling elements that enable a secure and tool-free snap and press fit connection between the central and extension channel bodies. This design reduces installation time and the risk of misalignment, which are common challenges in prior systems that rely on manual fastening methods or adhesive-only bonds. Additionally, the modular nature of the system provides enhanced flexibility in assembling drainage layouts. Prior systems often require complex, non-modular components, which limit adaptability on-site. The ability to easily connect and adjust extension channel bodies, joiner channel bodies, and end caps allows for customizable layouts suited to various project specifications, including the ability to incorporate non-linear channels. The introduction of an adjustable footer also offers a practical solution for leveling the system, a notable improvement over rigid, pre-leveled systems that lack on-site adjustability. This feature helps ensure a contiguous flow surface, preventing drainage issues caused by uneven installation surfaces. Moreover, the central channel body's variable width design offers more effective fluid management by facilitating an optimized flow capacity, which many prior systems fail to accommodate due to uniform channel widths. This enhances performance in diverse drainage scenarios, from light to heavy water flow. These disclosed embodiments address common limitations found in existing drainage solutions, offering a more adaptable, easy-to-install, and efficient system for managing water flow in various environments.

[0047] Referring now to the Figures, FIG. **1** is a view of a modular drainage system **100**, according to an example embodiment. The system **100** includes a central channel body **105**, acting as the primary conduit for water within the modular drainage system. The central body serves as the

backbone to which other modular components, such as extension channel bodies or end caps, can be attached. It is configured for the collection, channeling, and discharge of water to an external drainage system. The central channel body includes a bottom wall **110**, integrated with an outlet **115** for facilitating water egress. The bottom wall is a trough, which is a long, shallow, and V-shaped channel for directing water towards the outlet. The central channel body is characterized by its flanged portions **120** located at one or both end portions **122**, **124**, configured for modular connectivity. With additional reference to FIG. **3**A and FIG. **3**B, two opposing side walls **125** extend upwardly from the bottom wall, each including a ridge **305** on its inner surface **310** near the flanged portion for snap-fit connections with other components. The central channel body interacts with extension channel bodies, end caps, and adjustable footers through its modular design features, enabling the system to be elongated or adjusted according to specific installation requirements. The flanged portions and snap-fit mechanisms of the central channel body facilitate easy and secure attachment to other components, ensuring structural integrity and efficient water flow. The central channel body may be constructed from durable materials such as high-grade plastics, concrete, or metals, the central channel body is designed to withstand environmental stressors such as temperature variations, water exposure, and physical loads. These materials are important for their longevity, corrosion resistance, and ability to provide a stable and reliable drainage solution. Other materials may be included and are within the spirt and scope of the present disclosure.
[0048] The bottom wall **110** refers to the base part of the central channel body and extension channel bodies in the modular drainage system. It is the surface upon which water collects and flows towards the designated outlet. It serves as the structural foundation of the channel body, supporting the side walls and ensuring the entire assembly remains stable and secure when installed in the ground or a concrete base. The bottom wall is configured with a slight slope or gradient towards the outlet. This gradient promotes the efficient flow of water, minimizing stagnation, and ensuring that the drainage system effectively removes water from the area.
[0049] The outlet **115** is an aperture or opening located within the bottom wall of the central channel body and potentially extension channel bodies in the modular drainage system. Its primary function is to serve as the exit point for water collected within the drainage system, facilitating its controlled release into an external drainage system. The outlet is an interface between the modular drainage system and the broader external drainage infrastructure. It ensures that water collected by the system is efficiently directed away from the site, minimizing potential water damage to the surrounding area. Its size, shape, and placement are carefully calculated to ensure maximum efficiency in water egress, preventing overflow and stagnation within the channel body. The outlet is configured to allow for easy and secure connection to external drainage systems. This may involve standardized dimensions for compatibility with common piping and sewer systems, as well as provisions for attaching connecting hardware or sealing components to prevent leaks. In some embodiments, the outlet may incorporate features for regulating water flow, such as grates, filters, or valves. These components can control the rate of water egress, prevent the entry of debris into the external drainage system, and reduce the risk of blockage.
[0050] The flanged portion **120** is a protruding rim or collar, located at the ends of the central channel body within a modular drainage system. Its primary purpose is to enable a secure and watertight connection between adjacent channel bodies or between a channel body and other modular components such as extension channel bodies, end caps, or accessories. The flanged portion is configured with a specific shape that complements the connecting parts, ensuring a snug and precise fit. It extends around the perimeter of the channel body's end, providing a substantial surface area for attachment. Equipped with features such as, but not limited to, holes, grooves, or interlocking designs, the flanged portion is tailored to facilitate various types of mechanical connections. These can include bolted joints, snap-fit mechanisms, or adhesive bonding, depending on the system's requirements and the desired ease of installation or disassembly. In addition to

attachment, the flanged portion enhances the seal between connected components, preventing water leakage at the joints. This may be achieved through integrated gaskets, rubber seals, or by the precise engineering of the flange's surface to accommodate sealing materials. The flanged portion allows for the straightforward connection of channel bodies in a linear arrangement or for creating more complex configurations with angular or branching layouts. This modularity is essential for adapting the drainage system to specific site requirements, enabling easy expansion or reconfiguration as needs evolve.

[0051] Furthermore, two opposing side walls **125** extend upwardly from the bottom wall. The opposing side walls are vertical structures that rise from the bottom wall of the central channel body and extension channel bodies. They serve to contain the water within the designated flow path, preventing spillage and directing the water efficiently towards the outlet. These walls define the channel's capacity and ensuring its structural integrity when installed in various environments. The opposing side walls delineate the boundaries of the channel, ensuring efficient water management by guiding the flow towards the outlet. Each side wall is configured to be sufficiently tall to prevent overflow and robust enough to withstand the pressure exerted by the water and external forces, such as soil or pavement. The inward-facing surface of each side wall is smooth to minimize resistance to water flow, while the outward-facing surface includes elements for attachment or stabilization within the installation environment.

[0052] The ridges **305** is a raised feature or protrusion designed on the inner surface **310** of each side wall of the central channel body. Positioned close to the flanged portion, its primary purpose is to facilitate modular connections within the drainage system, contributes to the assembly and integrity of the system's structure. The ridge extends along the inward-facing surface of the side wall, acting as a guide or locking mechanism for attaching additional modular components, such as extension channel bodies or protective grates. Its design ensures a precise and secure fit, enhancing the stability and leak resistance of the assembled system. Its location near the flanged portion is strategic, enabling efficient and effective integration of the central channel body with other system components. This proximity allows for the ridge to play a key role in the modular system's overall functionality, particularly in ensuring seamless connections. The ridge's dimensions and profile are carefully designed to match corresponding grooves or slots in the components it connects with. This compatibility contributes to the ease of assembly and the integrity of the connection, ensuring components are securely locked in place without the need for additional fastening methods. The ridge interacts with other components of the modular drainage system by providing a mechanical means of connection and alignment. When components are aligned for assembly, the ridge engages with corresponding features on the adjoining component, such as tracks or grooves, ensuring a snug and secure fit. This interaction is fundamental to the modular nature of the system, allowing for the quick and easy addition or removal of components to meet specific installation needs.

[0053] The ridge allows for a more reliable and efficient modular connection system compared to other methods, such as adhesive bonding or complex mechanical fasteners, commonly found in prior art. This improvement simplifies installation and maintenance, reducing the time and effort required. By providing a secure locking mechanism, the ridge significantly enhances the structural integrity of the assembled drainage system. This design ensures a tighter, more leak-resistant connection between components, addressing a common shortcoming in previous systems. The ridge facilitates not only the easy assembly of the drainage system but also its disassembly and reconfiguration. This adaptability is a notable advancement, offering flexibility to adapt the system to changing needs or environments.

[0054] The system **100** also includes extension channel bodies **130**. The extension channel body **130** is essentially an elongated structural component that functions to extend the drainage system beyond the initial dimensions provided by the central channel body. The extension channel body functions as an additional segment that can be attached to the central channel body to customize the overall layout and length of the modular drainage system. It is designed to seamlessly integrate with the existing structure, ensuring efficient water management across extended or complex installation areas. The extension channel bodies include a second bottom wall **135**, mirroring the function of the central channel body's bottom wall, to support water flow towards the system's outlet(s). It also includes a second pair two side walls **140** extending upward from the bottom wall. These walls contain water within the channel. With additional reference to FIGS. **4**A and **4**B, the extension channel bodies in system **100** also include a track **405** on an outward facing surface **410** of each of the second pair of side walls. In system **100**, the extension channel body is substantially linear. The extension channel body allows for the customization and scalability of the drainage solution. It ensures that it can be easily integrated with the central channel body and system components like adjustable footers and end caps. This interoperability allows the system to adapt to various landscapes and installation requirements, ensuring effective water management across a wide range of scenarios.

[0055] The tracks **405** are a longitudinal groove or channel molded or constructed on the outer surface of each side wall in the extension channel body. It serves as a key element for the attachment of additional components or for facilitating the secure connection between the extension channel body and other parts of the modular drainage system, such as adjustable footers, connectors, or stabilization elements. The track is specifically engineered to accommodate corresponding protrusions, clips, or fastening mechanisms from other system components. Its design ensures a snug and secure fit, which contributes to maintaining the structural coherence and stability of the assembled drainage system. The dimensions, shape, and placement of the track are precisely calculated to match the connecting features of intended components, ensuring easy assembly and disassembly. This compatibility is essential for the modular nature of the drainage system, allowing for flexible configuration and reconfiguration according to specific installation requirements. Besides facilitating attachment, the track may also play a role in aligning components accurately, ensuring that they are positioned correctly for optimal functionality and efficiency in water management. The tracks provides a mechanism for secure and adjustable connections, such as engaging with the respective ridges of the central channel body. The tracks supports the system's ability to adapt to different layouts, lengths, and configurations, supporting the modularity that characterizes the drainage solution. It enables the swift addition of extension channel bodies, integration of adjustable footers for elevation adjustments, and attachment of end caps or other accessories as needed.

[0056] With refence to FIGS. **2**A and **5**A through **5**C, the extension channel body **205** in system **200** includes a second flanged portion **210** at least one end portion **215** of the extension channel body, according to an example embodiment. The extension channel body **205** includes ridges **505** on an inward facing surface **510** of the second pair of opposing side walls proximate to the flanged portion. The flanged portions with ridges in extension channel body **205** function similarly to the flanged portions with ridges in the central channel body **105** in FIG. **1**. The flanged portions are configured to facilitate a secure and watertight connection between the extension channel body and the tracks of another channel body, such as extension channel bodies **130**.

[0057] With reference to FIGS. **2**B and **6**A through **6**C, the extension channel body **220** may include a predefined angle defining an angular extension channel body, such that the angular extension channel body is configured to enable a directional change in the modular drainage system, according to an example embodiment. This feature allows the drainage system to navigate around obstacles, follow the contours of the installation site, or simply change direction according to the design requirements of the space. The angular extension channel body **220** is a variant of the extension channel body **205**, distinguished by its ability to change the direction of the drainage system. The angular extension channel body **220** includes the ridges **505** on the inward facing surface **510** of the flanged portion **210**. However, it also incorporates a predefined angle **225** into its structure, which dictates the new direction of the drainage path once installed. This predefined angle is important in the channel body's design, allowing for seamless directional changes without the need for additional fittings or complex modifications. The predefined angle is a specific, engineered bend within the body of the extension channel, allowing the drainage system to deviate from a straight path. This angle is designed to be a fixed value, such as 45°, 90°, or any other angle that meets the design specifications of the drainage project. The angular extension channel body is thus configured to enable a directional change in the modular drainage system, facilitating the layout's customization to accommodate site-specific requirements or to enhance the drainage efficiency by altering the flow path. The angular extension channel body allows for the construction of drainage systems that can efficiently navigate around obstacles, adapt to the shape of the landscape, or conform to the design aesthetics of the space. The angular extension ensures that the system remains cohesive and functional, maintaining a continuous flow path and structural integrity even as the direction changes. The integration of a predefined angle within the extension channel body signifies a significant advancement over traditional drainage solutions, which often require separate angled fittings or custom fabrication to achieve directional changes. This design simplifies the installation process, reduces the number of required components, and minimizes potential points of failure, such as leaks at the joints. By incorporating the angle directly into the channel body, the system offers enhanced flexibility and adaptability, making it easier to design and install efficient drainage systems tailored to specific environmental conditions and layout constraints.

[0058] The modular drainage system incorporates systems **100**, **200**, and **201** to create unique drainage pathways that can be tailored to different installation sites. The modular drainage system is configured to offer flexibility, adaptability, and ease of installation through the incorporation of different embodiments of extension channel bodies. These embodiments, which may include linear extension with tracks, linear extension with flanged portions, and angular extension with flanged portions, are important in creating a comprehensive system that can be customized to meet the specific requirements of any installation site. Leading to the central channel body, these extension channel bodies enable the construction of a drainage system that is both efficient in water management and versatile in design. The integration of these various extension channel body configurations with the central channel body enables the construction of a modular drainage system that is both robust and adaptable. By selecting the appropriate extension channel bodies-whether linear for straightforward extensions, angular for directional changes, or a combination thereof-installers can tailor the drainage system to specific site requirements. This modular approach not only simplifies the installation process but also enhances the system's functionality by ensuring efficient water management across diverse landscapes and architectural designs.

[0059] With reference to FIGS. **2**A and **7**A through **7**C, the system also includes an adjustable footer **700**. The adjustable footer is an innovative support mechanism that allows for vertical movement and secure positioning of the channel bodies at various heights. It also enables fine adjustments to the angle and slope of the channel bodies relative to the ground, ensuring proper alignment and efficient water flow towards the outlet. The adjustable footer interacts with the channel bodies of the modular drainage system by providing a stable base that can be precisely adjusted for height and level. This interaction is fundamental to the system's adaptability, allowing it to be installed in a wide range of environments with varying ground conditions. The adjustable footer ensures that the system remains properly aligned and effective in managing water flow, regardless of the installation surface's irregularities. Adjustable footers are typically made from durable, corrosion-resistant materials such as stainless steel, galvanized steel, or high-grade plastics. These materials are selected for their strength, durability, and ability to withstand environmental stressors, including moisture, soil acidity, and temperature fluctuations, ensuring the long-term reliability and performance of the drainage system. Other materials may be used and are within the spirit and scope of the present invention.

[0060] The adjustable footer **700** provides the ability to adjust the height and level of the drainage system provides unparalleled installation flexibility, allowing the system to be adapted to virtually any terrain or surface condition. This flexibility represents a significant advancement over fixed-support systems. By enabling precise adjustments to the slope and alignment of the channel bodies, the adjustable footer ensures optimal water flow towards the outlet, enhancing the efficiency of the drainage system compared to those without such adjustability. The secure connection and support provided by the adjustable footer enhance the overall stability and integrity of the drainage system. This stability helps prevent shifts or dislocations over time, improving the system's reliability and lifespan compared to prior solutions.

[0061] The adjustable footer **700** includes a height adjustment element **705** configured for allowing for vertical movement and secure positioning at various heights relative to a respective channel body. This element enables vertical of the channel body's position adjustments to accommodate varying installation depths and surface gradients. The height adjustment element may operate through mechanisms such as, but not limited to, a threaded rod, telescoping sections, or a ratcheting system that can be extended or retracted to raise or lower the channel body. This mechanism is engineered to provide smooth, precise adjustments. Once the desired height is achieved, the height adjustment element may include a locking mechanism, such as a nut, pin, or clamp, to securely maintain the channel body's position. This feature prevents unintended vertical movement, ensuring the system's stability and alignment.

[0062] The adjustable footer **700** further includes a leveling element **710** configured for enabling fine adjustments to the angle and slope of at least one of the respective channel body and ground to ensure proper alignment and efficient water flow towards the outlet. The leveling element is a mechanism incorporated into the adjustable footer, allowing for fine-tuned adjustments to the slope and angle of the channel body. Its primary purpose is to optimize the alignment of the drainage system, ensuring that water is efficiently directed towards the outlet, thus preventing stagnation and facilitating effective water management. The leveling element may operate through mechanisms such as, but not limited to, a pivoting mechanism, wedges, or adjustable supports that can be manipulated to alter the angle of the channel body. This mechanism is designed to offer precise control over the slope, enabling minor adjustments to achieve optimal water flow. After the desired angle or slope is achieved, the leveling element may include features to securely lock the adjustment in place. This may involve locking screws, bolts, or clamps that ensure the channel body remains at the set angle, maintaining system integrity and preventing shifts due to environmental pressures or loads.

[0063] The adjustable footer **700** further includes a main body **715** including a u-shaped fastener configured to abut the bottom wall of the respective channel body. The main body is a structural component designed to encase or abut against the bottom wall of the channel body within the drainage system. Its primary function is to provide a stable and secure base for the channel body, ensuring it is adequately supported and remains in the desired position and orientation. The U-shaped fastener is configured to match the profile of the channel body's bottom wall. This design allows for a snug fit, ensuring that the channel body is securely held in place. The “U” shape effectively cradles the bottom of the channel body, providing stability and support from underneath. The U-shaped fastener is engineered to facilitate easy yet secure attachment to the channel body. It may include mechanisms such as, but not limited to, clamps, screws, or bolts that lock the channel body into position, preventing any unwanted movement or displacement. While providing physical support, the main body is also designed to integrate seamlessly with the height and leveling adjustment elements of the adjustable footer. This integration ensures that adjustments to the channel body's position can be made without compromising the stability or security provided by the U-shaped fastener.

[0064] The adjustable footer **700** further includes a second ridge **720** on an inward facing surface **725** of the main body configured to snap fit into the track of the respective channel body. The second ridge is a protruding element on the inward-facing surface of the adjustable footer's main body. It is configured to engage with a corresponding track on the side walls of the channel body, facilitating a secure snap-fit connection. This design ensures a stable and reliable assembly of the drainage system components. The inclusion of the U-shaped fastener and the snap-fit ridge simplifies the installation process, reducing the need for complex tools or specialized labor. This ease of installation improves over more labor-intensive systems.

[0065] With reference to FIGS. **1** and **8**A through **8**B, the end cap **145** is a specifically designed closure that fits onto the ends of the channel bodies within the modular drainage system. Its primary function is to seal the system's ends, creating a watertight barrier that maintains the integrity of the drainage channel, prevents the ingress of debris, and ensures that water is directed towards the intended outlet points. The end cap includes an end cover body **805** configured to seal a terminal end of the modular drainage system. The end cover body is the main structural element of the end cap, crafted to fit snugly over the ends of the channel bodies in the modular drainage system. Its primary function is to create a watertight closure that completes the drainage channel, preventing external elements from entering the system and compromising its functionality. The end cover body is designed with exact dimensions to match the outer profile of the channel body it is intended to seal. This precision ensures a tight fit, effectively blocking the entry of debris and external water that could disrupt the drainage process. For example, incorporating gaskets, sealants, or specific design features like lip seals, the end cover body provides a watertight seal that enhances the overall performance of the drainage system. These features are important in maintaining the system's integrity under various environmental conditions.

[0066] The end cap further includes a third ridge **815** on an inner facing surface **820** of the end cover body configured to snap fit into the track on the side wall of the respective channel body. The third ridge is a protruding feature engineered on the inner surface of the end cover body, integral to the end cap of the modular drainage system. Its primary purpose is to facilitate a secure, tool-free snap-fit connection with a corresponding track located on the side wall of the channel body. This design ensures a tight and secure seal at the terminal ends of the drainage system, preventing debris entry and water leakage. The third ridge is precisely dimensioned to match the track on the channel body's side wall, allowing for a snug fit that securely locks the end cover body in place. While its primary role is to secure the end cover body to the channel body, the third ridge also contributes to the sealing effectiveness of the end cap. By creating a tight interlock with the track, it helps form a barrier against water and debris ingress.

[0067] The end cap interacts with the channel body by providing a secure closure that integrates seamlessly with the system's modular design. This interaction not only prevents water loss and debris entry at the system's ends but also contributes to the aesthetic completeness of the installation. The ease of connection, through a snap-fit mechanism, enhances the system's overall adaptability and maintenance efficiency.

[0068] Referring now to FIG. **9**, a flowchart diagram illustrating the steps for a method **900** of assembling the modular drainage system is shown, according to an example embodiment. The method starts with step **905**, wherein a user selects a central channel body and an extension channel body based on the desired length and configuration of a drainage system. This step may include evaluating the volume of water to be managed, which is influenced by factors such as the catchment area size, typical rainfall intensity, and any additional water sources (e.g., runoff from adjacent surfaces). This assessment helps determine the capacity required from the central channel body and any extensions. Understanding the physical characteristics of the installation site, including terrain slope, soil type, and existing obstacles or structures, is also important. This analysis informs the need for directional changes (requiring angular extension bodies) and the total length of the drainage system needed to effectively capture and redirect water. For retrofit installations or extensions to existing drainage systems, compatibility with current components and infrastructure must be considered. This ensures that new sections can be seamlessly added without compromising the overall functionality or requiring extensive modifications.

[0069] Based on the site analysis and water management needs, the user may calculate the total length of the drainage system required. This calculation should include any additional length needed to navigate around obstacles or to connect with existing drainage points. The user may also choose a central channel body that meets the capacity requirements for water flow and is suitable for the type of terrain and installation environment. The user may consider factors such as the channel body's depth, width, material, and load-bearing capacity. Based on the total length needed, the user selects the appropriate number and types of extension channel bodies. For straight runs, linear extension bodies will be required. If the system needs to navigate around corners or change direction, angular extension bodies with the correct predefined angles should be included in the selection. Additionally, the user may ensure that the chosen central and extension channel bodies have compatible modular features, such as flanged portions for secure connections and tracks or ridges for snap-fit accessories. These features simplify installation and future maintenance or expansion. Depending on the system configuration, additional components such as adjustable footers, end caps, and grates may be required. The user may select these components based on compatibility with the chosen channel bodies and the specific requirements of the installation site.

[0070] Next in step **910**, the user aligns the flanged portion of a central channel body with the track of the extension channel body. This process ensures a seamless and secure connection between the system's components, facilitating effective water management and structural integrity. Before aligning the flanged portions, the user ensures that the ground or installation surface is prepared and that both the central and extension channel bodies are positioned correctly according to the planned layout. This may involve leveling the ground and placing the channel bodies near their final installation points. The user carefully aligns the flanged portion of the central channel body with the flanged portion of the extension channel body. This involves matching the protruding flanges so that they are positioned to interlock or fit together snugly, ensuring that the connection will be secure and watertight. Once aligned, the flanged portion may be engaged with the track

[0071] Next, in step **915**, the user engages the flanged portions by applying pressure to snap fit the ridge of one channel body into the track of the adjacent channel body. Engaging the flanged portions of channel bodies in a modular drainage system involves a precise method of connecting components to ensure a secure and efficient assembly. This process utilizes the snap-fit mechanism, where the ridge on one channel body is designed to interlock with the track on the adjacent channel body. Once aligned, the user applies firm, steady pressure to the channel body with the ridge, pushing it towards the channel body with the track. The pressure is directed in such a way as to encourage the ridge to slide or snap into the track. For larger systems or in situations where manual pressure might be insufficient, tools or machinery designed to apply uniform pressure without damaging the components may be used. As pressure is applied, the ridges should begin to engage with the track. The user continues applying pressure until the ridge fully snaps into the track. This engagement may be accompanied by an audible click or a noticeable reduction in resistance, signaling that the connection is securely made. After the snap-fit engagement, the user may perform a visual and physical inspection to ensure that the connection is secure. There should be no visible gaps between the channel bodies, and the connection should resist minor forces without separating. The snap-fit mechanism provides a robust and secure connection between channel bodies, essential for maintaining the structural integrity of the drainage system. This secure engagement ensures that the system can handle water flow and external pressures without coming apart. Proper engagement of the flanged portions creates a tight seal that prevents water leakage at the connections. This seal contributes to the effectiveness of the drainage system, ensuring that water is directed appropriately through the system without loss or damage to the surrounding area. The snap-fit connection simplifies the installation process, allowing for quick and efficient assembly of the drainage system without the need for specialized tools or fasteners. This ease of installation saves time and reduces labor costs. Engaging the flanged portions through snap-fit connections enhances the system's modularity, allowing for easy expansion, reconfiguration, or maintenance. This flexibility is a significant advantage in adapting the drainage system to meet evolving needs or conditions.

[0072] Then, in step **920**, the user repeats the previous step for additional channel bodies as required to achieve the desired length and configuration. This iterative process ensures the system can be customized to specific site requirements, allowing for the efficient management of water over extended areas or around obstacles. The user determines the total length and configuration of the drainage system based on site evaluation, water management requirements, and any physical or environmental constraints. This assessment guides how many additional channel bodies are needed and what types (straight, angular, etc.) are required. The user adds channel bodies one by one, until the drainage system reaches the desired length and follows the planned configuration. Each addition is methodically connected and inspected to maintain the system's overall functionality and integrity. This step-by-step approach allows for the drainage system to be tailored precisely to the site's needs, accommodating specific lengths, shapes, and obstacles. The flexibility to add or modify the system configuration is essential for optimal water management. The modular design, facilitated by the snap-fit connections, provides scalability. The drainage system can be easily expanded or reconfigured in response to changing site conditions or water management needs. Additionally, by enabling on-site customization and adjustments, this process minimizes the need for extensive pre-planning or custom fabrication. It allows for efficient use of materials and labor, resulting in a cost-effective drainage solution.

[0073] Next, in step **925**, the user optionally adds angular configurations by selecting extension bodies designed for corners or bends and attaching them to the linear arrangement using the same snap-fit mechanism. This process allows the system to navigate around obstacles, change direction according to landscape requirements, or simply adapt to the design preferences of the installation site. Utilizing extension bodies with predefined angles enhances the system's flexibility and functionality, all while maintaining a straightforward installation process through the use of the same snap-fit mechanism employed for linear connections. The user may determine the points within the drainage system layout where directional changes are required. This could be due to physical obstacles, the need to route water to a specific location, or to conform with the perimeter of an area. The user may identify the appropriate angle needed for each bend or corner. The user may choose extension channel bodies with the predefined angles that match your system's requirements. Common angles include but are not limited to 45° and 90° bends, allowing for a variety of directional changes within the system. Similar to the linear channel bodies, the user aligns and applies pressure to engage the snap-fit mechanism, thereby securely connecting the angular extension to the linear arrangement.

[0074] Next, in step **930**, the user installs an adjustable footer to each respective channel body. This step ensures that the system is properly supported, level, and capable of efficient water management, while allowing for vertical and slope adjustments, accommodating various ground conditions and installation requirements. Prior to installation, the user may excavate the installation site to the desired depth, leveling the ground, or laying a base of compacted gravel or sand for stability and drainage beneath the footers. The user may consider the load requirements, environmental conditions, and the level of adjustability needed before choosing adjustable footers that are compatible with the specific channel bodies being used in your system. The spacing between footers will depend on the specific design of the drainage system, the type of soil, and the expected load on the system. The U-shaped fastener or support platform of the footer should snugly accommodate the bottom of the channel body, providing stable support. The adjustable footer may include mechanisms for securing the channel body (such as clamps, screws, or snap-fit features), which the user may engage to firmly attach the channel body to the footer. The user may ensure that the channel body is securely fastened and does not wobble or shift.

[0075] Adjustable footers provide a stable foundation for the drainage system, preventing shifting or settling that could compromise the system's efficiency or integrity. The use of adjustable footers accommodates uneven ground and complex installation scenarios, offering the flexibility to install a level and functional drainage system in a variety of landscapes. Properly installed and adjusted footers help distribute the load and stress placed on the drainage system, contributing to its longevity and reducing the need for maintenance.

[0076] Next, in step **935**, the user adjusts the height and level of each adjustable footer to ensure proper alignment and slope for efficient water flow towards an outlet. Before installing the channel body, the user may adjust the height of each adjustable footer to match the planned elevation of the drainage system. Use the footer's height adjustment mechanism to raise or lower the footer to the correct position. Additionally, the user may adjust the leveling element to ensure that the top of the footer is level, facilitating proper alignment and slope of the channel body for efficient water flow. Once the adjustable footer is correctly positioned and leveled, the user may place the channel body on top of the footer.

[0077] Next, in step **940**, the user sealing the terminal ends of the drainage system by attaching end caps to the ends of the channel bodies not connected to other channel bodies. This step ensures the system is closed off, preventing debris entry, soil ingress, and water leakage, thereby maintaining the integrity and efficiency of the drainage system. The user must align the end cap with the open end of the channel body. Once aligned, the end caps may be attached to the channel bodies. Properly sealed terminal ends prevent the system from becoming an entry point for debris, roots, or small animals, which could lead to blockages or damage. Sealing the ends ensures that all water is directed towards the intended exit points, preventing erosion or water damage to the surrounding area.

[0078] Next, in step **945**, the user places a grate over the top of the assembled channel bodies to provide a surface for water ingress. Placing a grate provides a surface for water ingress, ensures pedestrian safety, and prevents debris from entering the drainage system. This finishing touch not only enhances the functionality of the drainage system but also contributes to its aesthetic integration into the surrounding environment.

[0079] Referring now to FIG. **10**A and FIG. **10**B, perspective top and bottom views, respectively, of a modular drainage system **1000** in the assembled configuration is shown, according to an example embodiment. The central channel body **105** includes a trough **1005**, an outlet in the trough, a flanged portion defining an open end (**1025** in FIG. **3**A and FIG. **3**B) of the trough, a first side wall and a second side wall each extending upwardly from the trough, and a first coupling element on each of the first side wall and the second side wall of the flanged portion. Generally, a trough is a long, narrow, typically concave structure designed to hold or direct fluids or materials. In the modular drainage system, the trough serves as the primary channel through which water or other fluids flow, ensuring efficient transport from one point to another. It is open at the top, allowing water or other materials to enter, and features sloped or smooth interior surfaces that promote fluid flow towards an outlet. In the present embodiment, the cross-sectional shape of the trough is V-shaped. However, the cross-sectional shape of the trough can vary depending on the design, such as a U-shape to optimize fluid transport and minimize blockages. The trough is bounded by side walls **125** that extend upward, defining its depth and capacity. The lower part of the trough may be sloped to help guide fluid towards an outlet or junction point, where the liquid is transferred to another part of the system or into an existing drainage conduit. The width and depth of the trough can vary depending on the application, but its overall purpose remains to provide an unobstructed, efficient path for fluid flow.

[0080] With additional reference to FIG. **3**A and FIG. **3**B, the central channel body further includes a step **1010** defined by a riser between the flanged portion and an upper channel surface of the trough. The step refers to a structural feature within the channel body that creates a height differential or elevation change between the flanged portion and the main fluid-carrying surface of the trough. This step, formed by a riser, serves to transition between two distinct levels of the channel body, contributing to the system's design for modular connections, the step is an elevated section that is positioned between the flanged portion of the central channel body and the upper surface of the trough. The flanged portion defines the open end (**1025** in FIG. **3**A and FIG. **3**B) of the channel body and typically sits higher than the main surface of the trough, where fluid flows. The riser, a vertical or angled wall, forms the transition between these two surfaces—the upper surface of the flanged portion and the lower, fluid-carrying surface of the trough.

[0081] The central channel body further includes a first inner channel width between the first side wall and the second side wall of the flanged portion that is greater than a second inner channel width between the first side wall and the second side wall of the upper channel surface of the trough. The first inner channel width refers to the horizontal distance between the first side wall and the second side wall at the flanged portion, which defines the open end of the trough. The second inner channel width refers to the distance between the same side walls at the upper channel surface of the trough, located below the flanged portion. This larger width at the flanged portion allows the flanged portion of the central channel body to wrap around or overlap the extension channel body during assembly. This ensures a secure fit between the two bodies. The second inner channel width, located at the upper channel surface of the trough, is narrower and reflects the operational width of the drainage channel where fluid flow is concentrated. The first inner channel width is larger to create an overlapping connection point with the extension channel body, allowing the flanged portion to fit snugly around the extension channel body when they are coupled together. This fit ensures that the modular components of the system—such as the central channel body and extension channel bodies—can be assembled securely while maintaining a smooth, continuous flow surface between the connected bodies. This results in a more secure, stable, and leak-resistant connection between modular components.

[0082] The riser effectively creates a “step-down” from the elevated flanged portion to the trough. The flanged portion extends outwardly from the top edge of the channel's side walls, and this step configuration helps in guiding fluid down into the main trough while also allowing for modular attachments or connections, such as additional channel bodies or end caps.

[0083] The extension channel body **130** includes a second trough **1015**, a first side wall and a second side wall each extending upwardly from the second trough, and a second coupling element on each of the first side wall and the second side wall. The second trough of the extension channel body is a channel-like structure that allows for fluid flow, similar to the central channel body. The first side wall and second side wall extend upward from the trough's base, forming the boundaries of the channel. These side walls help contain liquid within the channel and prevent overflow. The second coupling element is positioned on each of the side walls, specifically designed to interact with the first coupling element on the central channel body or other extension bodies. In some embodiments, the second coupling element may be a snap-fit, tongue-and-groove, or similar mechanical design, providing a secure, interlocking connection when two channel bodies are joined. One important feature of the extension channel body is that it can be cut to specific lengths without losing the ability to connect via the coupling elements. This design flexibility allows the user to customize the channel length as needed, while still ensuring that the side walls and coupling elements can be properly aligned for connection. After the body is cut to the desired length, the second coupling elements on the side walls remain functional and can still engage with the corresponding first coupling elements on adjacent channel bodies. This ensures that even customized-length extension channel bodies can still provide a secure and stable connection, allowing for a leak-proof and structurally sound modular system. This ability to customize the extension channel body's length without sacrificing the integrity of the coupling mechanism provides a significant advantage over prior art, allowing for faster and more adaptable installation. It reduces the need for precision ordering or manufacturing of pre-set lengths, as installers can easily adjust the channel bodies on-site to meet specific needs, improving the overall versatility and ease of use in drainage installations.

[0084] The system includes an assembled configuration, shown in FIGS. **10**A through **11**A, having the extension channel body attached to the flanged portion of the central channel body such that the first coupling element of the central channel body is operatively coupled with the second coupling element of the extension channel body. In the assembled configuration, the interaction between the first coupling element of the central channel body and the second coupling element of the extension channel body contributes to forming a stable and efficient drainage system. The flanged portion, with its larger inner width, is designed to fit around the extension channel body when the two are connected. This overlapping design not only provides a secure mechanical connection but also ensures that the liquid flowing through the system moves seamlessly from the central channel body into the extension channel body without leaks or blockages.

[0085] An adjustable footer **700** is coupled to the extension channel body in the assembled configuration. An adjustable footer refers to a support mechanism that is attached to the extension channel body and provides stability and level adjustment to the drainage system. It can be vertically adjusted to accommodate different installation surfaces and ensure that the drainage channel maintains the correct position and slope. It is designed to provide vertical height adjustment to the drainage system, allowing for precise alignment of the extension channel body relative to the ground or surrounding surfaces. The footer includes a support beam, side walls, and a vertically adjustable mechanism that can be raised or lowered as needed to fit the specific requirements of the installation site. When the extension channel body is assembled with the adjustable footer, the footer is operatively coupled to the bottom or lower portion of the extension channel body, ensuring a stable connection that can support the weight of the channel body and maintain its position during fluid flow. The adjustable footer may include coupling elements configured to mate with the second coupling elements on each of the first side wall and the second side wall of the extension channel body. The footer's adjustability allows the system to be leveled or sloped appropriately to guide fluid efficiently towards the outlet. The adjustable footer prevents misalignment that could lead to inefficient drainage or water pooling.

[0086] The end cap **145** includes a third coupling element on the end cap operatively coupled to the second coupling element of the extension channel body in the assembled configuration. The end cap is designed to fit onto the open end of the extension channel body, thereby closing off the channel and preventing liquid from flowing out of that end. The third coupling element on the end cap is a mechanical connection feature, such as a snap-fit, tongue-and-groove, or other interlocking mechanism. This third coupling element is positioned on the side walls of the end cap and is engineered to align and interlock with the second coupling element located on the side walls of the extension channel body. When the extension channel body and the end cap are connected, the coupling elements engage to form a tight and secure fit, ensuring that the end of the channel is fully sealed. This connection is important for systems where the fluid needs to be directed to a specific outlet or controlled within the system, as the end cap prevents unintended leakage or spillage.

[0087] In some embodiments, the extension channel body includes a flanged portion at an open end of the second trough. The flanged portion of the extension channel body is an outwardly extending section located at the open end of the second trough, similar to flanged portion of the central channel body. This flanged portion is configured to fit around or engage with other extension channel bodies that do not have flanged portions. In this configuration, the flanged portion acts as a joining mechanism, allowing the extension channel body to connect with adjacent extension bodies seamlessly. The flanged portion on the extension channel body helps join extra extension channel bodies along one drain path. When an extra extension channel body without a flanged portion needs to be connected to the system, the flanged portion of the adjoining extension body fits around the non-flanged body, providing a support structure that aligns the components and ensures a tight fit.

[0088] In other embodiments, the extension channel body defines a non-linear shaped trough, or a non-linear joiner channel body. This means the channel is configured to deviate from a straight path, incorporating curves, angles, or bends. This non-linear design allows the drainage system to adapt to irregular or complex installation environments where a straight channel is impractical or undesirable. The non-linear shaped trough refers to a trough that does not follow a straight, linear path but instead includes curves, bends, or angular segments. The non-linear shape may be integrated into the structure of the extension channel body with flanged portions, enabling the system to accommodate various configurations, such as turns, corners, or meandering paths, to navigate around obstacles or fit into specific layouts. This feature is important in applications where the drainage system needs to follow irregular terrain or adapt to architectural features such as corners or curves. The trough's non-linear design could include curved sections for gentle redirection of fluid, or it could incorporate angular bends for more precise directional changes. The exact shape of the non-linear trough can vary depending on the specific use case, with the curvature or angles carefully engineered to maintain fluid flow efficiency. The non-linear extension channel body can connect with straight channel bodies of the drainage system via the coupling elements, forming a seamless transition between linear and non-linear components. This ensures that fluid flows uninterrupted through the entire system, regardless of the layout or shape of the individual channel bodies. Extension channel body **1020** includes both a non-linear shaped trough and flanged portions. Therefore, extension channel body **1020**, similarly to angular extension channel body **220**, can act as a joiner channel body while redirecting the trough path.

[0089] In the assembled configuration, adhesive **315** disposed on at least a portion of the flanged portion and an abutting body of the modular drainage system. The adhesive **315** is disposed on the surface of the flanged portion **120** (shown in FIG. **3**A) and the abutting surface of the adjacent body (shown in FIG> to ensure a secure, leak-resistant bond between the two components. The adhesive can be applied in the form of a liquid sealant, adhesive strips, or pre-applied bonding agent and is configured to strengthen the connection between channel bodies, preventing separation, leaks, or misalignment during operation. It is placed to cover the areas of the flanged portion and abutting body that come into direct contact during assembly, ensuring that the bond is strong and long-lasting.

[0090] The first coupling element, the second coupling element, and the third coupling element are elongated. Being elongated, these coupling elements are extended in length along a portion of the first side wall and second side wall of their respective components, rather than being confined to a small or specific area. The elongated design ensures that the components remain aligned and interlocked along a greater surface area, distributing the forces applied during operation more evenly across the joint. For example, when the extension channel body is connected to the central channel body, the second coupling element on the extension body interlocks with the first coupling element on the central body. The elongated nature of these coupling elements ensures that the connection runs along a significant portion of the channel walls, reducing the risk of misalignment, separation, or leaks under pressure. Similarly, the elongated third coupling element on the end cap engages with the second coupling element on the extension channel body, providing a secure seal at the end of the drainage system.

[0091] With reference to FIGS. **11**A and **11**B, the modular drainage system is shown, according to an example embodiment. FIG. **11**A is a top view of the modular drainage system, and FIG. **11**B is a front view of a cross-section A-A of the modular drainage system, according an example embodiment. The first coupling element, the second coupling element, and the third coupling element each include at least one recessed portion and at least one projecting edge. In the embodiments of the channel bodies including flanged portions, the projecting edges **1120** are similar to the ridges **305**, **505**, and **720** depicted in FIG. **3**A, FIG. **5**A, and FIG. **7**A, respectively. Each of the projecting edges **1120** are adjacent to recessed portions **1125** on the same side wall of the flanged portion. In the embodiments of the extension channel bodies without flanged portions, the recessed portions **1135** are similar to track **405** of FIG. **4**B. Each of the recessed portions **1135** are adjacent to projecting edges **1130** on the same side wall of the channel body. The projecting edges **1120** of the channel bodies including flanged portions fill into and mate with the recessed portions **1135** of the extension channel bodies without flanged portions. Simultaneously, the projecting edges **1130** fill into and mate with the recessed portions **1125**. Thus, the first coupling element, second coupling element, and third coupling element are mechanical features that enable secure interlocking connections between different parts of the modular drainage system. The recessed portion and the projecting edge together form a complementary interlocking mechanism. This configuration allows the components, such as the central channel body, extension channel body, and end cap, to fit tightly together, ensuring a stable and leak-proof connection. The recessed portion is an indented section of the coupling element that creates a groove or cavity on the side walls of the channel bodies. The recessed portion is shaped to receive and align with the projecting edge of the adjacent coupling element. The projecting edge is a raised section or lip on the opposite part of the coupling element, designed to fit into the recessed portion of the adjacent coupling element. For example, when the extension channel body is connected to the central channel body, the projecting edge of the first coupling element on the central body aligns with and fits into the recessed portion of the second coupling element on the extension body. This interlocking design prevents the components from separating or shifting once assembled. The recessed portion holds the projecting edge in place, ensuring that the parts remain aligned and tightly connected during use, even under pressure from fluid flow or environmental forces. The coupling design also helps prevent lateral movement or misalignment, which could lead to leaks or inefficient fluid flow. Additionally, this configuration improves the ease of assembly by providing a clear fit between components, guiding them into place during installation. The recessed portion and projecting edge ensure that the components are correctly oriented and connected, reducing the likelihood of improper assembly.

[0092] A contiguous flow surface **1105** is defined by the upper channel surface **1110** of the trough of the central channel body and upper channel surface **1115** of the second trough of the extension channel body. A contiguous flow surface refers to a continuous, uninterrupted surface along which fluid can travel smoothly from one section of the drainage system to another. In this context, it is defined by the upper channel surface of the trough of the central channel body and the upper channel surface of the second trough of the extension channel body. The design ensures that the two surfaces align seamlessly to create a unified path for fluid flow. When the upper channel surface of the central channel body's trough and the upper channel surface of the second trough are connected in the assembled configuration, their upper channel surfaces align perfectly to form a contiguous flow surface, meaning that there is no gap or misalignment between the two surfaces. This contiguous surface ensures that liquid flows smoothly from the central channel body into the extension channel body without disruption or turbulence. The design of this continuous flow surface contributes to preventing debris buildup, minimizing fluid resistance, and ensuring efficient drainage.

[0093] Referring now to FIG. **12**, a flowchart diagram illustrating the steps for a method **1200** of assembling a modular linear drainage system is shown, according to an example embodiment. The process of coupling in method **1200** and method **1300**, describe further below, includes the steps and processes of applying adhesive to the appropriate portions and applying a force to couple the corresponding coupling elements. These steps are similar to those described in steps **1205** through **1215**. It is understood by those skilled in the art that the steps of the methods described herein are not limited to the specific order presented. Unless explicitly stated otherwise, the method steps may be performed in different sequences, rearranged, or performed concurrently where appropriate without departing from the scope and spirit of the invention. The described order is merely one exemplary embodiment, and variations in the sequence of steps may be made based on the particular circumstances of the implementation, application, or design preferences.

[0094] For example, certain steps may be combined, omitted, or repeated depending on the operational conditions or requirements of the system. Accordingly, the scope of the invention should not be construed as being limited to the specific order of steps outlined in the methods.

[0095] Method **1200** begins with step **1205**, which includes applying an adhesive to at least one of the flanged portion of a first channel body, or central channel body, and the adjacent channel body, or extension channel body. The first channel body is the central channel body and includes a trough, the outlet in the trough, the flanged portion defining an open end of the trough, the first side wall and the second side wall each extending upwardly from the trough, and the first coupling element on each of the first side wall and the side wall at the flanged portion.

[0096] Applying an adhesive to the flanged portion of the central channel body involves the process of introducing a bonding agent to the flat, extended surface surrounding the open end of the trough. The adhesive creates a seal or bond between the flanged portion and another surface, which would usually be an extension channel body. When adhesive is applied to the flanged portion of the central channel body, it involves evenly spreading or dispensing the adhesive material along the entire perimeter of the flange to ensure complete coverage. The adhesive could be a waterproof bonding agent such as epoxy, polyurethane-based adhesive, or a silicone sealant, each chosen for their ability to provide a long-lasting, watertight seal. Once applied, the adhesive forms a thin, uniform layer over the flange. This allows the flanged portion to be securely pressed against the corresponding surface of another component, such as an extension channel body or joiner body, creating a robust, fluid-tight seal between the two surfaces. Care is taken to avoid air pockets or gaps during the application, as these could compromise the seal's integrity and lead to leakage.

[0097] Adhesives used in this process may include silicone sealants, polyurethane adhesives, epoxy resins, or butyl rubber sealants. These materials are selected for their waterproof properties, flexibility, and durability in challenging environments, such as wet conditions, temperature variations, or pressure fluctuations. In the present embodiment, rubber cement, or cement glue, is applied to the flanged portions of the first channel body and the adjacent channel bodies. Other adhesives configured to be applied between the flanged portion of a channel body and the adjacent channel body may be used and are within the spirit and scope of the present disclosure.

[0098] Then, in step **1210**, method **1200** includes applying a force such that the first coupling element operatively couples with a second coupling element on a side wall of the adjacent channel body via a snap and press fit. Applying a force to the extension channel body and the flanged portion includes asserting a first force in direction A that is greater than an opposing force in direction B of an abutting body of the modular linear drainage system to operatively couple the abutting body to the extension channel body and wherein a third force couples the first coupling element and the second coupling element.

[0099] The first coupling element is located on the side wall of the central channel body's flanged portion, while the second coupling element is located on the side wall of the extension channel body. Both coupling elements are specifically designed for a complementary snap and press fit, which means they are shaped to lock securely into each other when force is applied. The process of coupling involves aligning the central channel body with the extension channel body so that the respective first and second coupling elements are positioned directly opposite one another. A force is then applied, typically by pushing or pressing down firmly on the central channel body or the extension body, depending on the orientation. As this force is exerted, the first coupling element on the central channel body engages with the second coupling element on the extension channel body, causing them to “snap” into place. This snap fit occurs due to the elastic deformation of the coupling elements, which allows them to expand slightly and then return to their original shape, locking into each other. The press fit component of the action ensures that the two parts not only snap into place but also fit tightly together, eliminating any gaps or looseness between the components. This ensures a durable connection that prevents dislocation during use and maintains structural integrity under fluid pressure or other external forces. The snap and press fit coupling mechanism simplifies the installation process by eliminating the need for external tools, bolts, or adhesives, which are commonly required in older systems. This reduces installation time and labor costs while making it easier to assemble or modify the system on-site. The self-aligning nature of the coupling elements also reduces the risk of installation errors, such as misalignment or uneven connections, which can lead to leakage or structural instability in prior systems.

[0100] Asserting a first force greater than an opposing force refers to applying sufficient pressure to push the first channel body into engagement with the adjacent channel body. The third force arises from the interaction between the coupling elements-specifically, the friction generated by the recessed portions and projecting edges interlocking-which creates resistance that prevents the channel bodies from separating once they are coupled. The first channel body and the adjacent channel body are connected via coupling elements, which include recessed portions and projecting edges on both components. The process of coupling the two channel bodies involves applying a first force to overcome opposing forces, such as friction from the coupling elements, mechanical resistance, or misalignment, to bring the bodies together. The first force is applied to the first channel body, pushing it toward the adjacent channel body. This force must overcome opposing forces, such as the friction between the surfaces of the coupling elements and any slight resistance from the snap-fit design. The opposing force may also include surface roughness or natural resistance due to the tight tolerances of the coupling elements. As the first force is applied, the projecting edges of the first channel body begin to engage and fit within the recessed portions of the adjacent channel body and vice versa, starting the process of interlocking the components.
[0101] Once the first and second channel bodies are aligned and the coupling elements begin to engage, a third force is created through the mating of the recessed portions and projecting edges of the coupling elements. This third force results from the frictional resistance generated by the coupling elements pressing against each other, which effectively locks the channel bodies together, preventing them from separating. As the recessed portions of the coupling elements fully mate with the projecting edges, the third force is created. This third force is the frictional resistance that occurs when the coupling elements are fully engaged. The third force acts to hold the channel bodies together, preventing separation. It results from the mechanical interlock of the recessed portions and projecting edges, which press against each other and generate friction. This friction provides the necessary resistance to keep the channel bodies coupled securely, even under external forces such as water flow or pressure. Unlike the first force, which is manually applied, the third force is passive, resulting naturally from the interaction between the coupling elements. It ensures that once the coupling elements are engaged, the system remains stable without requiring additional fasteners.
[0102] As a result of step **1210**, method **1200** includes step **1215**, wherein the system couples the first channel body to an adjacent channel body.
[0103] Then, in step **1220**, method **1200** includes coupling the first channel body to a drain conduit such that the first channel body further comprises an outlet. The process of coupling begins by aligning the outlet in the trough of the central channel body with the opening of the existing drainage conduit. The outlet is a port through which fluid collected in the trough is directed into the conduit. Once the outlet and conduit opening are aligned, the first channel body is lowered into place. In some embodiments, a gasket or sealant may be applied between the outlet and the conduit to ensure a fluid-tight seal, preventing leaks. The first coupling element on each of the first and second side walls, located at the flanged portion, may also be used to secure the first channel body to adjacent components or fasteners connected to the conduit, further stabilizing the connection and ensuring the central channel body remains in place during use.
[0104] Then, in step **1225**, method **1200** includes coupling the adjustable footer to the extension channel body. The adjustable footer includes a base, a vertically adjustable side support, and coupling elements that attach it to the extension channel body. The extension channel body includes a trough and side walls, and may be configured to rest on the adjustable footer, which provides support and height adjustment. To couple the adjustable footer to the extension channel body, the footer is positioned beneath the body so that the coupling elements on the adjustable footer align with corresponding features on the side walls of the extension channel body. These coupling elements may include slots, clips, or hooks that are specifically designed to engage with the footer and ensure a secure connection. Once aligned, a force is applied to press or slide the coupling

elements of the adjustable footer into place with the side walls of the extension channel body. This connection may be achieved via a snap-fit, press-fit, or sliding mechanism, depending on the specific design of the system. The coupling must be strong enough to support the weight of the channel body and maintain its position during operation, especially when the system is handling fluid flow. Once attached, the adjustable portion of the footer allows for height modification. Typically, this involves rotating a threaded screw or moving an adjustable slider that raises or lowers the extension channel body to achieve the desired height and slope. This ensures that the upper channel surface of the extension channel body is level with other components, such as the central channel body, and provides a smooth, contiguous drainage path.

[0105] Next, in step **1230**, method **1200** includes adjusting a height and a level of the adjustable footer to slope the extension channel body such that an upper channel surface of the extension channel body is substantially flush with an upper channel surface of the central channel body to provide a contiguous channel to the outlet in the central channel body. The adjustment of the footer ensures that the extension channel body can be leveled and sloped correctly to maintain a consistent flow path with the central channel body. During installation, the height of the adjustable footer can be increased or decreased to precisely position the extension channel body at the right elevation. To create the correct slope for effective drainage, the installer adjusts the height of the footer to ensure that the extension channel body is angled appropriately, allowing gravity to guide the flow of fluid toward the outlet. The leveling of the extension channel body contributes to ensuring that its upper channel surface is at the same height as the upper channel surface of the central channel body. This flush connection between the two surfaces is necessary to prevent disruptions in fluid flow, such as turbulence, backflow, or pooling, which could occur if there were any steps or gaps between the channel bodies. Once the footer is adjusted, the extension channel body becomes sloped and aligned with the rest of the drainage system, creating a contiguous channel that guides fluid seamlessly to the outlet in the central channel body. Maintaining this alignment contributes to ensuring that the system performs effectively under varying conditions, such as uneven terrain or different installation environments.

[0106] Then, in step **1235**, method **1200** includes coupling a first flanged portion of a joiner channel body to the extension channel body. The joiner channel body allows for attachments for another extension channel body. Therefore, in step **1240**, method **1200** includes coupling a second extension channel body to a second flanged portion of the joiner channel body.

[0107] Next, in step **1245**, method **1200** includes coupling an end cap to the second extension channel body. When the required length or span of drain path is covered, the user may end the drain path with an end cap. This end cap prevents fluid in the trough from flowing past it and contributes to guiding the fluid towards the drain outlet in the central channel body.

[0108] Referring now to FIG. **13**, a flowchart diagram illustrating the steps for a method **1300** of tailoring the length of the modular drainage system is shown, according to an example embodiment. Method **1300** begins with step **1305**, which includes coupling central channel body to the drain conduit similarly to step **1220** in method **1200**. This step allows the user to measure the distance from step of the central channel body to a shower grate in step **1310** of method **1300**. The distances measured may also include longitudinal and latitudinal distances from step to the shower grate. The distance measured may depend on the route that the existing shower system allows for.

[0109] Then, in step **1315**, method **1300** includes cutting the extension channel body to the desired length. Cutting the extension channel body involves trimming the body at one of its ends, making sure that the coupling elements (such as second coupling elements) are left intact to allow for proper interlocking with the other components in the system. The cut needs to be precise to ensure that when the extension body is coupled to the adjoining component, such as the central channel body, the surfaces align flush to maintain the integrity of the fluid flow. By customizing the length of the extension channel body, the system can adapt to different installation environments, including varying distances between key components. This flexibility ensures that the drainage system can fit into tight spaces or accommodate irregular layouts, all while preserving the proper alignment and slope needed for fluid drainage.

[0110] The cutting process for the extension channel body can be carried out using a variety of cutting tools, depending on the material of the channel. Tools may include, but are not limited to, hand saws or hacksaws for cutting through materials like HDPE or PVC, power tools like circular saws or reciprocating saws for faster and more precise cuts, especially when working with tougher materials such as stainless steel, and pipe cutters or miter saws can also be used for precision cuts in specific applications.

[0111] Next, in step **1320**, method **1300** includes coupling the extension channel body to the central channel body via snap fit, similarly to step **1215** in method **1200**. Then, in step **1325**, method **1300** includes coupling the end cap or the second extension channel body. In either case, the coupling process is tool-free and quick, relying on the snap-fit mechanism to ensure a secure and precise connection. Coupling an end cap or the second extension channel body depends on whether the required distance is met. If the required distance is not met, then the user would couple the second extension channel body to elongate the trough path.

[0112] Although the subject matter has been described in language specific to structural features and/or methodological acts, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as example forms of implementing the claims.

Claims

1. A modular drainage system comprising: a central channel body comprising: a first trough; an outlet in the first trough; a flanged portion defining an open end of the first trough; a first side wall and a second side wall each extending upwardly from the first trough; and a first snap and press fit coupling element on each of the first side wall and the second side wall of the central channel body proximate to the flanged portion; an adjacent channel body comprising: a second trough; a first side wall and a second side wall each extending upwardly from the second trough; and a second snap and press fit coupling element on each of the first side wall and the second side wall of the adjacent channel body that spans a substantial portion from a first end of the adjacent channel body to a second end of the adjacent channel body; a footer removably attachable to at least one of the first snap and press fit coupling element and the second snap and press fit coupling element.

2. The modular drainage system of claim 1, wherein the central channel body further comprises a step defined by a riser between the flanged portion and an upper channel surface of the trough.

3. The modular drainage system of claim 1, wherein the central channel body further comprises a first inner channel width between the first side wall and the second side wall of the flanged portion that is greater than a second inner channel width between the first side wall and the second side wall of an upper channel surface of the trough.

4. (canceled)

5. The modular drainage system of claim 1 further comprising: a contiguous flow surface defined by an upper channel surface of the trough of the central channel body proximate to an upper channel surface of the second trough of the adjacent channel body.

6. (canceled)

7. The modular drainage system of claim 1, wherein the adjacent channel body further comprising a closed end portion defining.

8. The modular drainage system of claim 1, wherein the adjacent channel body comprises a flanged portion at an open end of the second trough.

9. The modular drainage system of claim 1, wherein the adjacent channel body comprises the second coupling element on an outer facing surface of each of the first side wall and the second side wall.

10. The modular drainage system of claim 1, wherein the adjacent channel body comprises a bend defining a non-linear shaped trough.
11. The modular drainage system of claim 1 further comprising adhesive disposed on at least a portion of the flanged portion of the central channel body adhering it to and an abutting the adjacent channel body in an assembled configuration.
12. (canceled)
13. The modular drainage system of claim 1, wherein the first snap and press fit coupling element and the second snap and press fit coupling element collectively define (i) a male component having an upper elongated ridge disposed above a lower elongated ridge and a groove disposed between the first elongated ridge and the second elongated ridge, and (ii) a female component having an upper groove disposed above a lower groove and an elongated ridge between the upper groove and the lower groove.
14. A modular drainage system comprising: a central channel body comprising a first trough; an outlet in the first trough; a flanged portion defining an open end of the first trough; a first side wall and a second side wall each extending upwardly from the first trough; a first coupling element on each of the first side wall and the second side wall of the central channel body proximate to the flanged portion of the central channel body; an extension channel body comprising a second trough; a first side wall and a second side wall each extending upwardly from the second trough; and a second coupling element on each of the first side wall and the second side wall of the extension channel body; an end cap having a third trough with an open end, a terminating end wall, a first wall and a second wall extending upwardly from the third trough, and a third coupling element on each of the first side wall and the second side wall of the end cap; an assembled configuration comprising the first coupling element of the central channel body operatively coupled to the second coupling element of the extension channel body at a first end of the extension channel body, and the third coupling element of the end cap operatively coupled to the second coupling element of the extension channel body at a second end of the extension channel body; wherein each of the first coupling element, the second coupling element, and the third coupling element is an elongated snap and press fit coupling element and comprises at least one ridge and at least one groove; wherein the second coupling element of the extension channel body spans substantially all of the length of the extension channel body from the first end of the extension channel body to the second end of the extension channel body.
15. The modular drainage system of claim 14 further comprising an adjustable footer comprising a support beam; a first side wall and a second side wall extending upwardly from the support beam; a fourth coupling element on each of the first side wall and the second side wall of the adjustable footer; a vertically adjustable side support; and a base pivotably coupled to the vertically adjustable side support.
16. The modular drainage system of claim 15 further comprising a joiner channel body comprising a fourth trough with open ends, a first side wall and a second side wall each extending upwardly from the fourth trough; a flanged portion at each open end of the fourth trough; and a fourth coupling element on each of the first side wall and the second side wall of the joiner channel body at each flanged portion of the third trough, wherein the fourth coupling element is a snap and press fit coupling element that is elongated and comprises at least one ridge and at least one groove.
17. A method for assembling a modular linear drainage system, comprising: coupling a first channel body to an adjacent channel body; wherein the first channel body comprises a first trough, a flanged portion defining an open end of the first trough, a first side wall and a second side wall each extending upwardly from the first trough, and a first snap and press fit coupling element on each of the first side wall and the second side wall of the first channel body, wherein the first snap and press fit coupling element is proximate to the flanged portion of the first channel body; wherein the adjacent channel body comprises a second trough, a first side wall and a second side wall each extending upwardly from the second trough, and a second snap and press fit coupling element on

each of the first side wall and the second side wall of the adjacent channel body; wherein the first snap and press fit coupling element and the second snap and press fit coupling element collectively define (i) a male component having an upper elongated ridge disposed above a lower elongated ridge and a groove disposed between the first elongated ridge and the second elongated ridge, and (ii) a female component having an upper groove disposed above a lower groove and an elongated ridge between the upper groove and the lower groove; wherein the first channel body is coupled to the adjacent channel body by applying a force to each of the first side wall and the second side wall of each of the first channel body and the adjacent channel body causing the first snap and press fit coupling element to mate with the second snap and press fit coupling element.

18. The method of claim 17 comprising coupling at least one of the first channel body and the adjacent channel body to a shower drain conduit such that at least one of the first channel body further comprises an outlet in the first trough and the adjacent channel body comprises an outlet in the second trough.

19. The method of claim 18 comprising, before coupling the first channel body and the adjacent channel body, applying an adhesive to at least one of the flanged portion of the first channel body and an end portion of the adjacent channel body.

20. (canceled)
